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w/ Exhibits

[1507/6]

7/13/95

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	Paul MARSHALL
Serial No.	:	08/267,108
Filed	:	June 27, 1994
For	:	VIRTUAL REALITY GENERATOR FOR USE WITH FINANCIAL INFORMATION
Examiner	:	C. Butterworth
Art Unit	:	2311

Hon. Assistant Commissioner
for Patents
Washington, D.C. 20231

DECLARATION OF PAUL MARSHALL UNDER 37 C.F.R. § 1.132

I, Paul Marshall, declare as follows:

1. I am the sole inventor of the above-identified application.

2. I have a Bachelors of Arts in Economics from Columbia College and I am currently a M.B.A. candidate in Finance and International Business at the Leonard N. Stern Graduate School of Business Administration at New York University. I am currently the Executive Director and a Principal of Maxus Systems International, a partnership that provides financial software and consulting services to the financial community. Maxus Systems International markets a virtual reality financial information system, which I developed and for which I filed the above-identified application, under the trade name METAPHOR MIXER.

3. Prior to my work at Maxus Systems International, I was the Director of International Derivative Arbitrage at Spear, Leeds, & Kellogg, L.P. In this position, I implemented and co-managed an international derivative hedge fund, investing in warrants, convertible bonds, options and futures. In addition, I initiated and integrated strategic trading and analytic software with outside consultants.

4. Prior to my work at Spear, Leeds, & Kellogg, L.P., I was the International Securities Lender for the Teachers Insurance and Annuity Association College Retirement

Equities Fund (TIAA-CREF), one of the world's largest pension funds. At TIAA-CREF, I was responsible for maximizing income for the fund's $3 billion international equity portfolio. While at TIAA-CREF, I also co-developed, with outside software consultants, a PC-based system that provides equity pricing, portfolio management, and advanced analytics on Japanese equity and equity-derivative markets. This PC-based system incorporated multi-tasking, a graphical user interface, and three-dimensional modeling in the analysis of hedging and arbitrage opportunities relative to underlying equities.

5. In view of my education and experience as indicated in ¶¶ 2-4, I consider myself to be at least a person of ordinary skill in the art of virtual reality generators, and in particular virtual reality financial information systems.

6. My patent application is directed to a virtual reality generator which dynamically displays inputted financial information as a virtual reality world that allows a user of the virtual reality generator to move through and interact with the displayed financial information.

7. I have read the Office Action dated March 15, 1995 in the above-identified application. I understand that the United States Patent and Trademark Office ("the Patent Office") has rejected my application, taking the position that the virtual reality generators described in claims 85-125 are obvious over a number of articles cited by the Examiner, in particular, Cyberarts: Lanier of VPL on "Voomies" by Rohrbough (the "Rohrbough article") and Virtual Reality: a status report by Jacobson (the "Jacobson article"), in further view of Virtual reality offers growing opportunity for risk takers by Hindus (the "Hindus article"), Virtual Reality is almost real by Saffo (the "Saffo article"), PV-wave for Financial Applications ("PV-Wave 1"), PV-Wave Command Language ("PV-wave 2"), and PV-Wave Point and Click Visual Data Analysis Software ("PV-Wave-3").

8. Also based on my reading of the March 15, 1995 Office Action, I understand that the Patent Office takes the

position that in view of the Rohrbough and Jacobson articles, the level of one skilled in the art at the time my application was filed "was such that no undue experimentation would have been needed" to build a virtual reality generator according to my invention.

9. I have read the references listed in ¶ 7.

10. Neither the Rohrbough or the Jacobson articles, either individually or in combination, suggest that the level of one skilled in the art at the time my application was filed "was such that no undue experimentation would have been needed" to build a virtual reality generator according to my invention. In particular, the development of the virtual reality generator according to my invention required expertise in at least the fields of virtual reality and finance. As I stated in ¶¶ 2-5, I possess expertise in each of these areas. As no such finance information is described in the Rohrbough or Jacobson articles, the omission of such information, which is necessary for the development of a virtual reality financial information system, cannot support the position that in view of the Rohrbough and Jacobson articles, the level of one skilled in the art at the time my application was filed "was such that no undue experimentation would have been needed" to build a virtual reality generator according to my invention.

11. The Rohrbough article describes general statements on the development of virtual reality, as of November 1991, in the opinion of a Jaron Lanier, the chief executive of VPL Research at that time. In particular, the Rohrbough article does not provide any information related to the unique issues presented in developing a virtual reality system which maps abstract information, such as financial information, to a virtual reality object, such as polygons or chips or any other virtual reality object. The only suggestion or arguable teaching of a virtual reality system in the Rohrbough article is reference to existing virtual reality systems used, for example, for building design. Such a system, however, maps real world information, e.g., a

building, to a real world object, e.g., a virtual reality building. Such an example does not provide sufficient information to enable one skilled in the art to make, as recited in my patent application, a virtual reality generator receiving financial information and having:

> a user interface module ... filtering the financial information to comply with the plurality of filter parameters; and
>
> a virtual reality generator module generating, continuously modifying, and displaying on a display device a virtual reality world being a three dimensional interface that enables the user to simulate movement through and interact with the financial information ....

12. The Jacobson article describes a status report on the development of virtual reality as of August 1991. The Jacobson article does not provide any information related to the unique issues presented in developing a virtual reality system which maps abstract information, such as financial information, to a virtual reality object. The only discussion of an actual virtual reality system in the Jacobson article is reference to existing virtual reality systems used, for example, for building design and for medical research. Such systems, however, map real world information, e.g., a building or a molecule, to a real world object, e.g., a virtual reality building or molecule. Such examples do not provide sufficient information to enable one skilled in the art to make, as recited in my patent application, a virtual reality generator receiving financial information and having:

> a user interface module ... filtering the financial information to comply with the plurality of filter parameters; and
>
> a virtual reality generator module generating, continuously modifying, and displaying on a display device a virtual reality world being a three dimensional interface that enables the user to simulate movement through and interact with the financial information ....

13. I also refer to an article by William Bricken, attached hereto as Exhibit A. In this article, Mr. Bricken, a leading developer and theoretician in virtual reality, states

that virtual reality is multidisciplinary and a hybrid technology in which it is necessary to link very widespread disciplines. Thus, the failure of the Rohrbough and Jacobson articles to provide information from the financial discipline demonstrates that these articles, in view of the Bricken article, do not suggest that the level of one skilled in the art at the time my application was filed "was such that no undue experimentation would have been needed" to build the virtual reality financial information system.

14. The nonobviousness of my invention also is demonstrated by evidence of commercial success, industry praise and copying by competitors.

15. The virtual reality generator recited in claim 34 of the above-identified application is sold by my company, Maxus Systems International, under the trade name METAPHOR MIXER.

16. Since the METAPHOR MIXER was made available for sale, there have been sales of over $200,000. Included in the sales are purchases of the METAPHOR MIXER by: TIAA-CREFF, one of the world's largest pension funds; British Telecom; ABD/Dresdner Securities; and a $100,000 contract with the United States Department of Defense. Evidence of this commercial success, along with several articles reporting this commercial success, is attached hereto as Exhibit B.

17. The commercial success of the METAPHOR MIXER identified in ¶ 13 is directly derived from the virtual reality generator claimed in the above-identified application in a marketplace where the consumers are free to choose on the basis of objective principles. The commercial success is not the result of heavy promotion or advertising, a shift in advertising, consumption by purchasers normally tied Maxus Systems, or other business events extraneous to the merits of the claimed invention.

18. In addition to commercial sales, the METAPHOR MIXER has received numerous awards and industry praise as the world's first and leading virtual reality financial information system.

19. Linda Jacobson, the author of the Jacobson article relied on by the Patent Office in rejecting my application, has provided industry praise and acknowledged that the METAPHOR MIXER was the "first financial visualization application for VR" in an introduction to Chapter 17 of the book HOW VIRTUAL REALITY WORKS. A copy of the relevant excerpts from HOW VIRTUAL REALITY WORKS is attached hereto as Exhibit C.

20. Additional industry praise which reflects the nonobviousness of my invention is the nomination of the METAPHOR MIXER for a 1994 *Computerworld Smithsonian Award* in the Finance, Insurance & Real Estate Category by Intel Corporation, one of the world's leading innovative computer companies. A copy of the nomination is attached hereto as Exhibit D. This award is widely recognized as the most prestigious award in the computer industry honoring innovative uses of information technology. In addition, by being nominated for the *Computerworld Smithsonian Award*, the METAPHOR MIXER is now part of the permanent research archive of the Smithsonian Institution.

21. Further industry praise supporting the nonobviousness of my invention is the selection of the METAPHOR MIXER for the financial analysis world of a virtual reality display at the Guggenheim Museum Soho in New York from October 23 to November 1, 1993. The Press Release and a brochure for the display are attached hereto as Exhibit E. The METAPHOR MIXER was one of five virtual reality worlds selected for display at the Guggenheim Museum. Also attached hereto as exhibit F is an article from the premier issue 1994 of the VIRTUAL REALITY REPORT describing the virtual reality display at the Guggenheim Museum Soho and which states that the METAPHOR MIXER is "the first to harness VR as a means to visualize, navigate and mine these vast seas of rapid-fire data."

22. The METAPHOR MIXER also has received significant industry praise as the first and leading virtual reality financial information system and has been featured as

such in numerous financial and computing magazines. A copy of articles from magazines including FORBES, AI, AMERICAN BANKER and RISK are attached hereto as Exhibit G.

23. The present invention is being copied by competitor virtual reality companies. A copy of the advertisements for vrTRADER and VISIBLE DECISIONS, attached hereto as Exhibit H, clearly show direct copying of the METAPHOR MIXER virtual reality financial information system.

I hereby declare that all the statements in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true. Further, all the statements herein were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under U.S.C. § 1001 and that such wilful statements may jeopardize the validity of the application or any patent issued thereon.

Date: July 17, 1995

Paul Marshall

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CyberEdge Journal®
The World's Leading Newsletter of Virtual Reality

Exhibit A

Coming Up

- **SID Intl. Display Rsch.**
  Oct. 10-13, 1994
  Hyatt Regency Hotel
  Monterey, CA, USA
  Contact: Palisades Institute Attn: IRDC '94, 201 Varick St., New York, NY 10014 USA, 212 620-3341, FAX: 212 620-3379
  PAPERS
- **VR Entertainment & Developers Expo**
  Oct. 11-13, 1994
  Bally's Casino Resort
  Las Vegas, NV, USA
  Contact: SIG Advanced Apps, 1562 First Ave., Suite 286, New York, NY 10028 USA, 212 717-1318, FAX: 212 861-0588
- **Visualization '94**
  Oct. 17-21, 1994
  Sheraton Premiere
  Tysons Corner, VA, USA
  Contact: IEEE, 1730 Massachusetts Ave. NW, Washington, DC 20036-1992 USA, 510 423-9368, vis94@lini.gov

CyberEdge Journal Interview:

William Bricken Speaks

Interviewed by Aaron Cieslicki

William Bricken has been one of the most dynamic developers and theoreticians in VR since he left artificial intelligence research at Advanced Decision Systems to work on VR systems at Autodesk in (1988-89) and joined the Human Interfaces Technology Lab (HITL) at the University of Washington (1990-94). His research includes a large number of VR tools and operating systems, programming languages, and philosophical investigations of cyberspace. In January of this year, he left HITL to join In World, a company developing VR for the fitness industry. Recently, CyberEdge Journal probed his perspective on the VR industry.

CyberEdge Journal: The VR industry is, for the most part, incestuous: companies sell products to other companies in the industry. How and when will non-entertainment VR sell to end users outside the industry?

William Bricken: Right now, there is no mass market outside of the VR industry. The only field that looks like it will grow significantly over the next 2-3 years is entertainment, in video games, location based entertainment and theme park attractions. It will take a very large investment in non-entertainment VR, $100 million nominally, to build a VR application industry with a significant market base. Until some company in education or architecture or medicine spends that money, the market base isn't going to be established. As for how long that takes, I'd say that with an investment in the $100 million range, primary and secondary markets could be well established in 3-5 years. The first principle in moving out of the hype and into the real marketplace is to focus on a product that will sell to customers who are not fluent in computer technology. That's the first step, like going from zero to one. One successful mass market product would open the door for all of the other appealing applications.

What's missing is a team that has competence across all of the technical areas and business areas.

CEJ: Besides money, what is preventing a, marketable product from completion? Is it hardware, software, design, or business skills?

WB: VR is multidisciplinary, it's a hybrid technology. The individual components you mentioned are fairly well understood at this point. What's missing is a team that has members with competence across all of the technical areas and the business areas. In VR it is necessary to link very widespread disciplines. VR combines interaction techniques from artificial intelligence with real time programming from operating systems technology with aesthetic design and artistic judgment. Finding a person, or a group of people, that have skills in all of those areas at the same time in the same place is the real bottleneck in the industry. A second bottleneck is that the VR community still largely thinks that VR is a simulation of physical reality, which it is not.

CEJ: What does the partnership of the academic and business worlds, like the one HITL proposes, mean to the industry?

WB: Getting a good team together is very easy in an academic environ- Continued page 16.

Readers' Roundup

Continued from previous page.

that we have come to expect from run of the mill VR books: the history, the overview, the crystal-ball gazing, the ugly-muddy reproduction of the photos. It even does a somewhat better that average job with all these prerequisites. But what makes *ExCursions* worthwhile is what is added: a real programmer's guide, with examples and code. The programs are not particularly exciting, but they do provide a good basis for the budding VR wizard, with clear explanations and well-constructed code. If you are already working in VR programming, you won't find much new here. But if you need some help learning to program virtual worlds, skip the first 148 pages and get right to the heart of the matter. Then you'll find the real value in this volume.

Published by Academic Press Professional, Cambridge, MA, USA, ISBN: 0-12-737865-0, soft cover, illustrated, indexed, includes disk and 3D glasses, US$39.95.

CyberEdge JOURNAL
The World's Leading Newsletter of Virtual Reality

Coming Up

- **Workshop on Virtual Environments**
  Oct. 24-25, 1994
  Coimbra, Portugal
  Contact: Prof. Doutor Jose Carlos Teixeira, CCG/ZGDV - Centro de Computacao Grafica, R. de Mocambique, 17 r/c Esq., 3000 Coimbra, Portugal, +351 39 702646, Fax: +351 39 702647, teixeira@mat.uc.pt

- **Autodesk University**
  Oct. 24-27, 1994
  Georgia World Congress Ctr.
  Atlanta, GA, USA
  Contact: Miller Freeman, 600 Harrison St., San Francisco, CA 94107 USA, 415 905-2354 FAX: 415 905-2220 ***PAPERS***

- **Intl. Conf. on VR Applications, Research, Products**
  Oct. 24-28, 1994
  Adelaide Conf. and Exhibition Ctr.
  Adelaide, South Australia
  Contact: Alan Yates,Integra Computing, Innovation House, First Avenue, Technology Park, 5095, Australia, (61) 260 8972, Fax: (61) 349 6566, xarjf@levels.unisa.edu.au ***PAPERS***

Bricken

Continued from page 14.

ment, compared to the industrial environment. However, the culture of academia, that is, where academics are going, doesn't really match up very well to the culture of business. One problem is, for instance, that the work I did at HITL was intended for public domain and wasn't protected for business profits.

HITL was created to transfer technology from academia to business, but there are difficulties with this idea of technology transfer. First it means taking people out of the academic setting and moving them into industry. Most academics don't want that.

Second, as far as the university goes, new, hybrid technologies like VR don't fit well into accepted disciplines or departments. VR is not computer science, it's not the fine arts, it's not electrical engineering, it's not psychology; it's a little bit of all of them.

Third, what's happened is that most of the technical work in VR has grown up outside of the academic environment. Laboratories doing military research and labs like the one I directed at Autodesk have done a great amount of work. In a very real sense, academics are playing catch-up to industry in VR. The direction of transfer is really from business to academia; business is teaching the university how to develop ideas and make them profitable. I suspect that the marketplace is now firmly in control of VR research.

CEJ: What are your short term and long term projections for the industry?

WB: From the long term perspective, VR is not the next interface, not another neat application. It is a complete redefinition of symbol processing to make computation and computers usable to people. VR isn't an application, it's a way to deal with information.

I'll put this in the context of technology growth as a whole. Look at technology, and, in particular, computer technology, as something that is evolving. Compared to automobiles, right now we're 20-30 years into the development of the tool. In car terms, we're just getting to the Model T stage. Or, in broadcasting terms, we're still doing stand-up, black and white television.

At this moment, my computer screen is flashing magnificent color to me with an easy to use desktop interface and lots of computing power. Yet, we should see that entire system, in long term perspective, as completely antiquated — very early in the development stage. At this point, with a keyboard and a mouse, using a computer is like speaking a foreign language. With a VR interface, you use the same skills that you use in social interaction. It removes symbolic mediation. You don't have to go through a layer of words and scripts and scenarios and texts and codes that require a lot of cognitive effort to figure out.

Only two apps

There are only two applications that are floating the whole computer industry. One is text processing, where the computer is an evolved typewriter. The other is spreadsheets, where the computer is an evolved ledger book. Both of these are highly textual, and not at all VRish. Our economy, and the global economy, is becoming heavily based on the transfer of information. One hundred, two hundred years ago it was the transfer of mass, in a very general sense. Now it's information that drives the economies of countries, but we have few tools and fewer concepts to deal with that information. We're back in the pre-industrial era in our ability to deal, sensibly, with information. We're treating information as though it were mass. VR has the capacity to overcome that. Information interaction or information navigation is the key concept. This is far broader than whether you're using the computer. The telephone is a VR system with a very narrow bandwidth. This meeting is in cyberspace, on the telephone. We don't truck information packages from my home to yours.

So VR defines a completely new application for computers in generating experiences. In that sense it's the same thing that books and television and movies are trying to do. In that sense all media are currently immature in their ability to interact with a person.

In the short term, entertainment is definitely the only place where there's any market growth for VR. There's a lot of hope and talk about education and training, but the economies of these fields don't justify the costs of VR systems yet. There's a lot of talk about medicine, but the high performance expectations of the medical community aren't really available in VR systems yet. There's a lot of talk about architectural walk through and design, but our ability to abstract what design means isn't there yet. We don't know how to computerize the concept of design. We can build a house in VR from detailed plans, but VR is not yet a place for imaginative creation. Continued next page.

CyberEdge JOURNAL
The World's Leading Newsletter of Virtual Reality

VR '94: The Exhibits

More, and Better

By Ben Delaney

There were forty-six companies listed in the exhibition catalog at VR '94, held May 11-13, 1994 in San Jose, California. Late sign-ups meant that the number of actual exhibitors was greater. Three and one half years ago, at the first Meckler VR conference, there were nine exhibitors. That's a greater than 500% increase in exhibitors. There are many more VR companies not yet ready or able to set up at a show. This may very well be recorded as the time when VR became a legitimate business. There was a lot of other evidence, too.

Especially encouraging is that the hucksters (the people claiming that their flashing-light glasses are VR, that their 3D photos are VR, that their recorded erotica is VR) are almost gone. Almost without exception, what we saw in San Jose were real VR products, real VR applications, and real VR business being conducted.

One could look at this show as a thermometer, and also a barometer. It was hot, make no doubt about it. Mecklermedia is claiming that nearly 6,000 people went through the show floor. The venue was changed to accommodate them, to the San Jose Civic Auditorium, a block from the sessions at the Fairmont Hotel. Many exhibitors told us that not only were there plenty of people, but there were serious buyers among them. Obviously, there were more suits and fewer Continued next page.

Coming Up

Human Factors & Ergonomics Soc.
Oct. 24-28, 1994
Nashville Conv. Ctr.
Nashville, TN, USA
Contact: HFES, PO Box 1369, Santa Monica, CA 90406-1369 USA
310 394-1811
FAX: 310 394-2410

Bricken

Continued from previous page.

CEJ: Why was it the right time in January for you to leave HITL and re-enter the business world with In World?

WB: When we started building VR systems at HITL in 1989, it was apparent that there were a number of questions that were unanswered. We didn't know how to market, or even design something that was cost-effective for industry. Even more important were the set of driving questions about the psychology.

After doing four years of research at HITL, we have some answers. It is also apparent that the economic milieu of the industry had strengthened. In 1989, looking at five years to do research was perfectly reasonable. Now I'm looking at five years to build the market base. Outside of entertainment, we're looking at another five years of R&D to deliver what consumers are demanding of VR. I'm still seeing five years out before there's any mass market. The outstanding issue is to make systems that are cost effective and have a high enough performance that people like using them.

I spent of all of 1993 at HITL creating and testing spin-off companies. There were three or four before In World that gave us good indications as to where the opportunities were. In 1994 the time was right to convert the accumulated research results into a commercial product. And besides, no one has yet built the VR dream deck.

InWorld VR, Inc.

CyberWand™ 3-D Navigational Device

InWorld's *CyberWand*™ is a hand held, self contained, low cost navigational device for use in VR and multi-media applications. Users can navigate through virtual environments without the constraint of being attached to a desktop navigation device. Features include 4-DOF Onboard HAT sensor, 4 independent button switches, installable Polhemus Sensor option and multiple sensor capability. Also included are two separate software libraries for low level DOS-Windows platforms and WorldToolKit™ users. Comes complete with software, manual and ACM gamecard.
Price: low-level version, $99.95; LL and WorldToolKit™ version $114.95.

ThrustMaster™ Sensor Library V1.01

Designed for WorldToolKit™ users, the *ThrustMaster™ Sensor Library* will allow developers to incorporate the full range of uses the *ThrustMaster™* brand analog joysticks and rudder pedals can provide. Up to 8 4-DOF joysticks, HATs and rudder pedals can be accessed simultaneously. The *Library* contains 12 individual update functions for use in WorldToolKit™ and 23 low level functions for developing your own drivers. By providing multiple switching on the joystick controls themselves, *ThrustMaster™* devices can dramatically improve the performance capabilities of VR applications. *Price: $100., call for hardware pricing. DOS platforms only, call for availability of Windows and UNIX Versions. (Version 1.0 users, call for your free update kit.)*

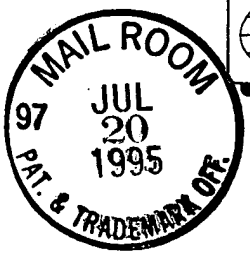
InWorld™ VR, Inc. designs and constructs real time three dimensional interactive computer software for use in virtual reality as well as in a variety of industrial and artistic applications. For information regarding consulting services for your projects, please contact InWorld™ at the numbers listed here.

144 Buchanan Drive
Sausalito, CA 94965
(415) 331-5004
or (805) 564-8785
Internet: inworld@rain.org

WorldToolKit™ is a trademark of Sense8 Corp. ThrustMaster™ is a trademark of ThrustMaster, Inc. InWorld and CyberWand are trademarks of InWorld VR, Inc.

Maxus Systems International

Exhibit B



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Paul Marshall
Executive Director

25 Fifth Avenue
New York, N.Y. 10003
Tel. (212) 777-8621

Dec. 10, 1992

Mr. Curt Snyder Jr.
Vice President
S. G. Warburg & Co. Inc.
787 Seventh Avenue
New York, New York 10019

Dear Curt:

The following services are provided to CREF by Maxus Systems International with the understanding that the costs will be paid by S. G. Warburg & Co. Inc

- Software licensing of and custom computer software programming to the Capri and Metaphor Mixer Systems rendered January 1 through December 31 1992, technical support and customized consulting.

The fees for the above services are $50,000. We will forward any further invoices to Jay Koehler at the above address.

Regards,

Paul Marshall

Accepted by:
Date:

S. G. Warburg & Co. Inc.

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Maxus Systems International

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Paul Marshall
Executive Director

25 Fifth Avenue
New York, N.Y. 10003
Tel. (212) 777-8621

June 27, 1993

Mr. Jay Koehler
S. G. Warburg & Co. Inc.
787 Seventh Avenue
New York, NY 10019

Dear Jay,

The following services are provided to CREF by Maxus Systems International with the understanding that the costs will be paid by S. G. Warburg & Co. Inc.

- Software licensing of the Capri and Metaphor Mixer Systems rendered January 1 through June 30 1993.

The fees for the above services are $17861.25-- 6 month license $16,500 + $1361.26 NY Sales Tax.

Regards,

Paul Marshall

Accepted by:
Date:

S. G. Warburg & Co. Inc.

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MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

JUL 14 10 03 AM '95

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ABD SECURITIES CORPORATION

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041	SUBSCRIPTIONS & PUBLICATION IS	611-0060	6/01/93	693	4,871.25

ABD SECURITIES CORPORATION

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041	SUBSCRIPTIONS & PUBLICATION IS	712-0200	7/01/93	793	4,871.25

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041 SUBSCRIPTIONS & PUBLICATION IS 810-0110 8/01/93 89300 4,871.25

ABD SECURITIES CORPORATION

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041 SUBSCRIPTIONS & PUBLICATION IS 915-0270 9/09/93 993 4,871.2

ABD SECURITIES CORPORATION

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041 SUBSCRIPTIONS & PUBLICATION IS 1011-0180 10/01/93 1093 4,871.25

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041 SUBSCRIPTIONS & PUBLICATION IS 1108-0130 11/30/93 113193 4,871.2

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100655

MAXUS SYSTEMS INTERNATIONAL
25 FIFTH AVENUE-SUITE 6F
NEW YORK, NY 10003

920770041 SUBSCRIPTIONS & PUBLICATION IS 1217-0230 12/01/93 1293 4,871.2

Maxus Systems International

Specialists in International Derivative Securities
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25 Fifth Avenue, Suite 6F
New York, NY 10003
Tel (212) 777-8621
August 2, 1993

Mr. Andre Taylor
BT North America Inc.
100 Park Avenue, 13th Fl.
New York, NY 10017

Dear Andre,

Here is the invoice for our first quarterly consulting arrangement agreed to by Steve Davies of BT CBP Group in London.

INVOICE RE: BT/Maxus Joint Venture	Invoice: BTJV0893C

Consulting Services to be rendered 8/1/93-10/31/93.
To include on-site demonstrations of Maxus's products to prospective clients and preliminary work towards integration of Maxus's products with BT's OTS View suite of market datafeed software products.

Maxus Systems Tax ID Number: 13-3343712

TOTAL	$50,000

If you have any questions please call me on (212) 777-8621.

Sincerely yours,

Paul Marshall
Executive Director

UNITED STATES MARINE CORPS
MARINE CORPS SYSTEMS COMMAND
2033 BARNETT AVE SUITE 315
QUANTICO, VIRGINIA 22134-5010

IN REPLY REFER TO

CTQ-1/A:LRB:220

30 Mar ..

Maxus Systems, International
Mr. Paul Marshall
200 Winston Tower, Apt 2318
Cliffside Park, NJ 07010

Subject: Marine Corps SBIR
Topic N95-048

Dear Mr. Marshall:

Please be advised that your proposal, entitled "A Fully Networked C4I Visualization System," submitted to the Marine Corps under DoD Solicitation 95.1 has been selected for funding. Congratulations!

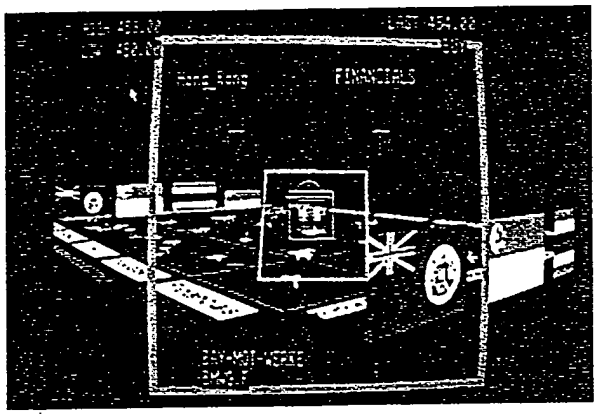
We have initiated the process of entering into a contract with your firm. You will be contacted in the near future by a representative of a government procurement office who will negotiate the specific terms of the contract.

Sincerely,

DORINNE M. RIVOAL
Contracting Officer
Marine Corps Systems Command

Play Money

We've always believed that virtual reality was too good to be wasted on ordinary reality. Now a company called Maxus Systems is using it to represent the alternative reality of Wall Street. Their system, called Metaphor Mixer, represents investment options as a kind of Vegas game table with floating color chips



and "profit missiles." Now in use by a number of securities firms, including ABD Securities (a US arm of the German Dresdner Bank), the Metaphor Mixer links professional expertise to visual sensibilities.

Metaphor Mixer, says Paul Marshall of Maxus, is a virtual reality system that "allows the client to 'fly' over the entire financial world," represented as a huge grid with each square corresponding to a country and industry group. Real-time data reports are fed into the system; stocks are represented by color-coded shapes. Spinning and blinking shapes symbolize various performance patterns – spinners, for example, represent optimal price to earnings ratios – and "profit missiles" home in on attractive securities. There's even a kind of agent – a "wingman" that can be dispatched to look for particular mathematical market features. The system, which uses the Spaceball 3-D input device, is based on Sense 8 Corporation's World Toolkit software for creating 3-D virtual spaces. So far, the system only guides decision making, but one can easily imagine the day when trades themselves are placed by clicking on a chip. Metaphor Mixer suggests a model for the virtual trading floor of the future.

We'd love to see a home version – the VR equivalent of Quicken – in which you can plunge down the abyss of your MasterCard balance, ascend the compounding interest of Mt. Optima, or struggle across the vast desert of a 30-year fixed mortgage, while the glimmering mirage of a hot stock tip dances in front of your eyes. Maxus Systems: +1 (212) 481 3688. – *Phil Patton*

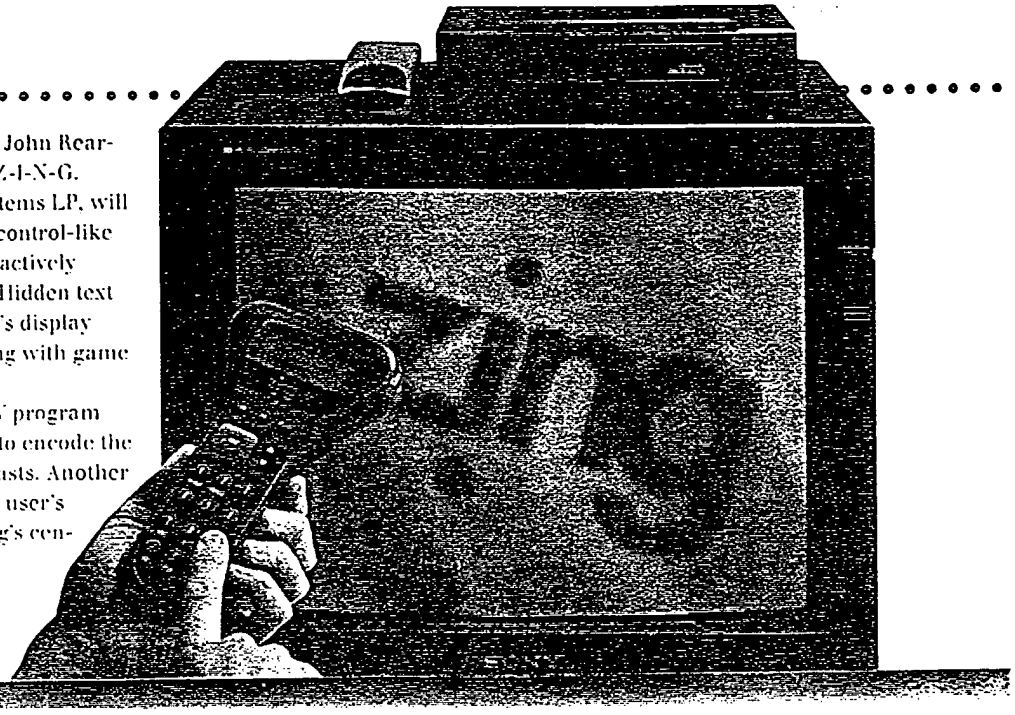
TIRED	WIRED
Post-Cold War Recession	The Wired Expansion
Dogma	Karma
The Pope	The Dalai Lama
Bill	Boris
Esquire	*Warp*
Manhattan	Ft. Worth
Time	Warner
MTV	mtv.com
Location Based Entertainment	VRcades
Orlando	Las Vegas
Cable TV	Bell Atlantic
Schwarzenegger	Stallone
Armies	Warlords
vt100	SLIP
FCC	Unlicensed bandwidth
Bell bottoms	Chinos
Smashing Pumpkins	Dead Can Dance

> game than the less-than-perfect graphical world of *Speed Racer?* Speed's Mach 5 has been updated with a video screen and various other cool gadgets, but all the supporting cast will appear in the new game, set for release for both Nintendo and Sega early next year. At least the animators repurposing Speed for the gaming world won't have to worry about synchronizing his voice to his lips. ☰!! More Trials: When you first heard about the Time-Warner/SGI/General Instruments interactive television trials in Orlando, Florida, you probably wondered why your zip code wasn't the first pit stop on the information buyway. Well, if you live in Omaha, Nebraska, you're in luck: US West, 3DO, and a yet-to-be-named software company, supplying the language, interface and OS, are teaming up to bring more than 100,000 Omaha customers their personal vision of interactive TV by the end of next year. Still feeling left out? Keep lobbying, there should be enough alliances formed

Skinner TV

How do you spell interactive television? John Reardon, former president of MTV, spells it Z-I-N-G. Reardon's latest cable venture, Zing Systems LP, will soon offer "The Zing Device," a remote control-like unit that will allow viewers to become "actively involved" with their favorite TV shows. Hidden text messages, seen only on the Zing Device's display screen, will prompt viewers to play along with game shows and to order products.

Using a Zing Developer's Tool Kit, TV program producers and advertisers will be able to encode the hidden text messages into their broadcasts. Another unit (the Zing Dialer), connected to the user's phone, will send responses back to Zing's cen-



Trust and Investments

ABD's Global Traders Test Virtual Reality

BY WILLIAM PESEK JR.

Edward Santalone

GEORGE M. GABRIEL, vice president of foreign institutional trading at ABD Securities, uses a virtual-reality system to follow more than 1,200 issues daily.

It would probably be safe to say that most bankers perceive "virtual reality" as little more than a New Age entertainment medium rather than a tool to be wielded in their buttoned-down professional lives.

But with an eye on the future, some investment banks are turning to this most rarified of high technologies to give them an edge in rapid-fire financial markets.

ABD Securities Corp., the New York-based securities trading arm of Dresdner Bank, for instance, is using a pioneering system that allows its traders to visualize data in animated, graphic form rather than on spreadsheets or in cumbersome reports.

Sort of the Apollo moon-shot of computer technology in the financial services business, the firm, with $235 million in assets, has decided to take one giant step forward with a data distribution and display system, called the Metaphor Mixer. The software, developed by New York-based Maxus Systems International, helps traders grasp otherwise unmanageable amounts of complex information.

"Seeing [graphic-oriented data] is faster and better than reading where real-time markets are concerned," said George M. Gabriel, vice president of foreign institutional trading at ABD.

The use of virtual reality on a trading floor is based on the premise that the brain is much better equipped to grasp data presented as three-dimensional graphics than as numbers or text. Traders access this information simply by pointing to a menu of symbols displayed on the screen.

Staying on top of the markets is key at ABD because the firm serves as a broker-dealer in numerous equity markets around the world and provides trading, execution, and clearance functions for global institutional and private clients.

Mr. Gabriel, like most international traders, is responsible for keeping tabs on more than 1,200 issues at any moment of the day. That means monitoring the movement of stocks from a whole slew of exchanges, including Frankfurt, Tokyo, Hong Kong, and Singapore.

Continued on page 22A

At a Glance

ABD Securities Corp., subsidiary of Dresdner Bank

Hardware
AST Research Corp. 486 personal computer

Software
Maxus Systems International Capri and Metaphor Mixer virtual reality software
Microsoft Corp. Windows
Sense8 Corp. WorldToolKit

ABD Traders Get Jump on Markets with Virtual-Reality System

Continued from page 4A

Metaphor Mixer – which is installed at ABD using a personal computer from AST Research Inc., Irvine, Calif., with an Intel Corp. 80486 microprocessor – provides an electronic medium for simplifying large amounts of information. It also helps traders identify opportunities and discern the patterns and trends in financial markets.

"The level of detail the system offers is a significant step because of the kind of power and visualization it puts in the hands of traders," said Donald E. McNees, vice president and director of the New York financial services consulting practice at Towers Perrin.

"When those windows of opportunity open, they don't stay open for all that long," Mr. Gabriel said.

True to its roots, Metaphor Mixer looks like a cutting-edge video game. The screen is a jamboree of colors and shapes, each assigned with a different meaning. It is controlled by a hand-held device called a spaceball. But a glorified Pac-Man it's not.

How does it work? The screen gives sort of a bird's-eye view of a large playing field. The field is marked off into rectangles. One side of the grid lists industry groups – finance, paper, utilities, electricals, and so on. The other side is broken down into various stock exchanges. In each rectangle there are several different colored electronic poker chips, each indicating a stock in an industry group.

The colors of the chips are important. For example, red means that the stock is down from the day before; blue, that the stock is up; and gray, that the stock is little changed from the previous day.

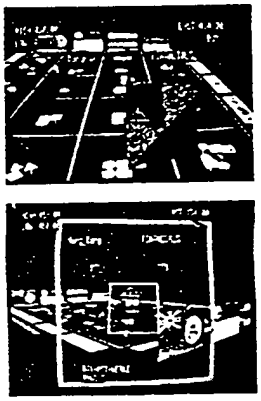
The movement of the chips is equally important. A spinning chip indicates that the stock has very attractive fundamentals. If a chip is blinking, some lucrative arbitrage opportunities have cropped up.

The next factor to watch for is the relative position of the chips. How far above or below the surface of the playing field tells you how far up or down the stock is trading relative to the rest of the market that day.

Traders can also get a closer look. Using the spaceball, the user can swoop down to the field or underneath it. Mr. Gabriel can get the name of an individual stock and all the particulars by clicking the spaceball on it.

"If things are hectic, I can look at the screen and get an instant perspective," he said.

As far as industry observers are concerned, the jury is still out on virtual-reality trading systems. "Most investment bankers I've dealt with still like to see the numbers on a spreadsheet," said Stan D. Monsowitz, director of financial services consulting at the marketing development unit of Cap Gemini America Consulting, New York.



METAPHOR MIXER **from Maxus Systems produces a graphic representation of stock market activity.**

Metaphor Mixer "might make life easier for some traders, but I don't know if it could be a real big seller."

Others, however, say that the rise of global investment opportunities and the booming popularity of derivative products have created an even bigger market for tools like this.

"The technological level required to analyze these markets is making it more of a technology race" than anything else, said Mr. McNees of Towers Perrin. "The person with the fastest capability to focus on the trading opportunity and the know-how to execute it will have the premium."

Mr. Gabriel's boss agrees. "To get an edge in the markets, you have to have some special tools on the trading desk," said Herbert Doenges, manager of ABD's equities and fixed-income trading areas.

From his vantage point, Mr. Gabriel believes ABD's virtual-reality trading system will help the firm's relatively small 140-employee investment bank compete against the Wall Street powerhouses. □

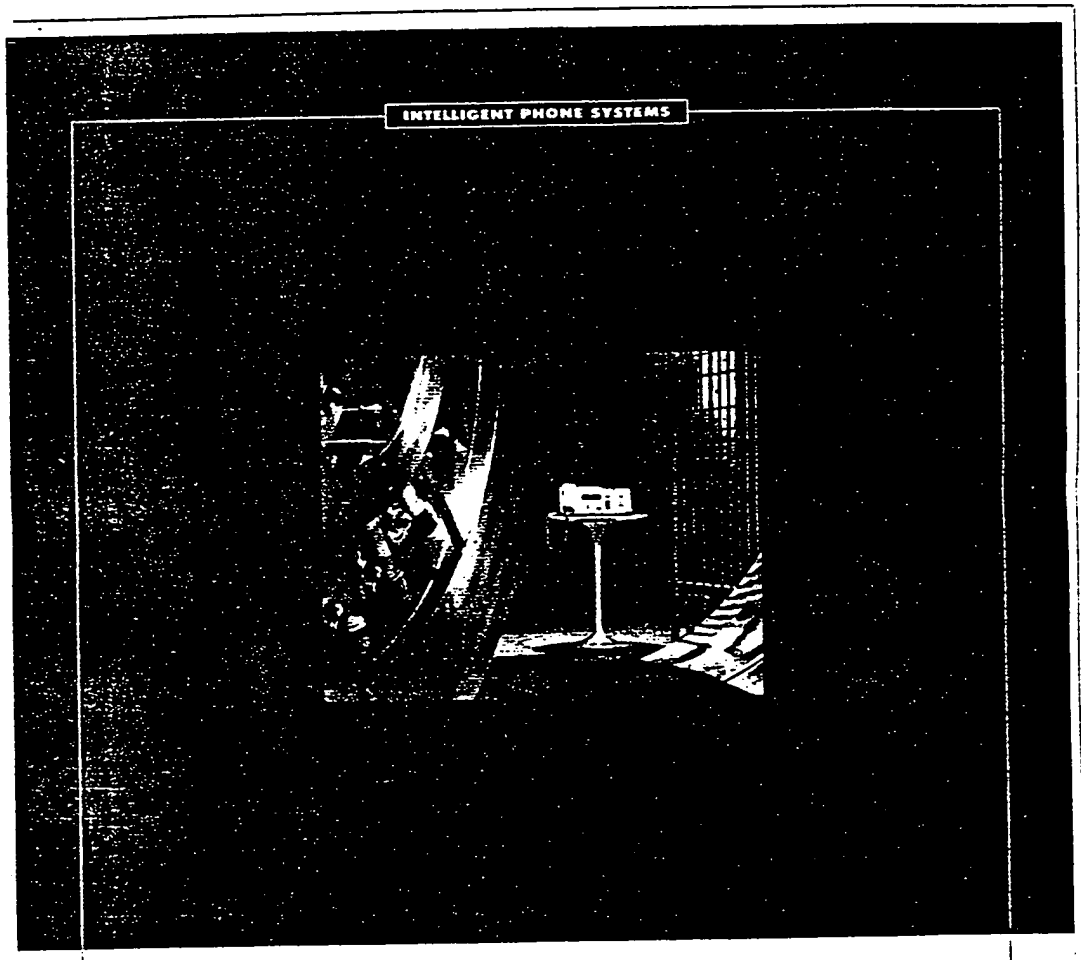


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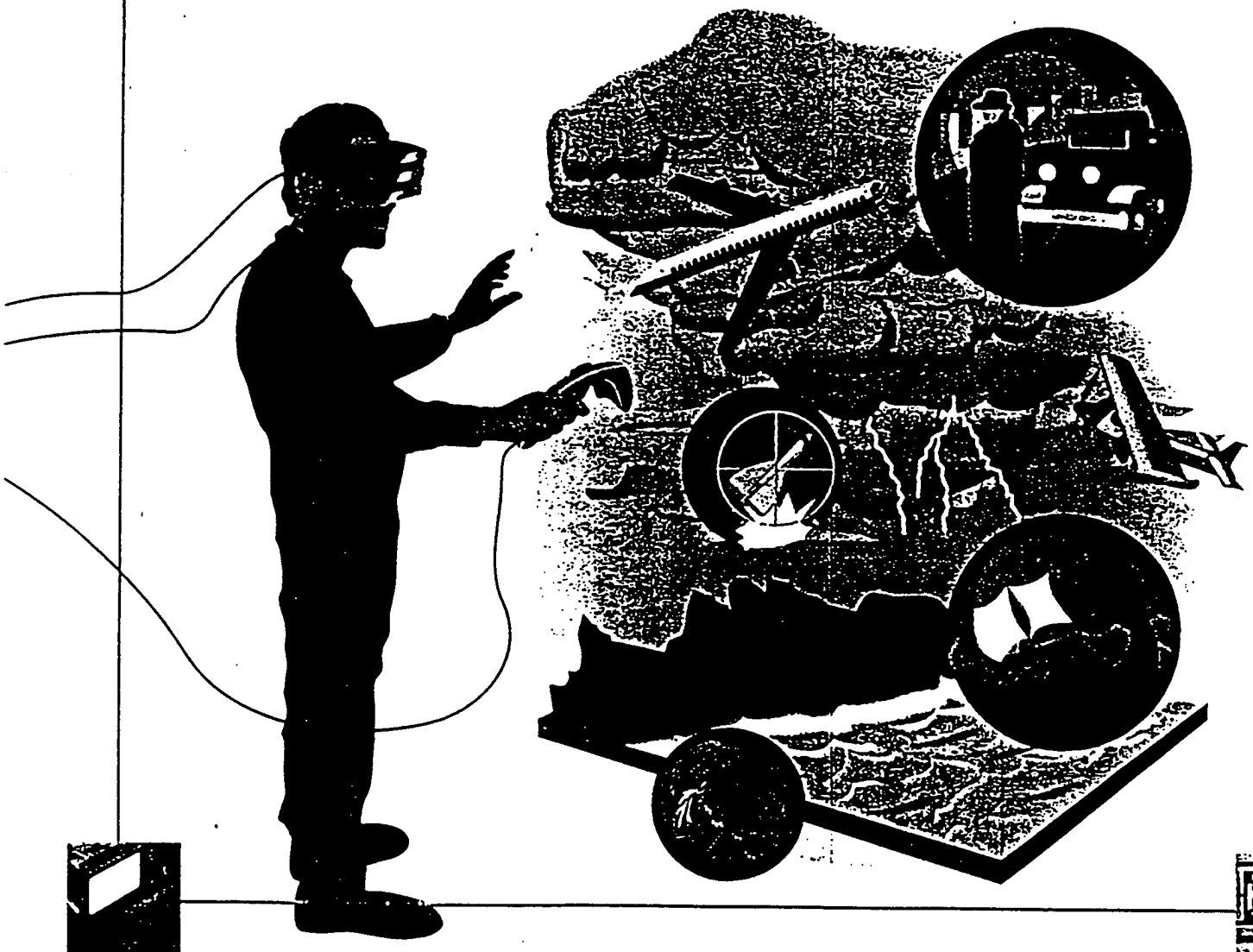
Exhibit C

HOW VIRTUAL REALITY WORKS

JOSHUA EDDINGS
Illustrated by PAMELA DRURY WATTENMAKER
Edited by LINDA JACOBSON



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How Virtual Reality Works
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Financial Visualization

LIKE ITS SCIENTIFIC counterpart, financial visualization converts large amounts of alphanumeric data into graphics or visual objects, making the data easier to interpret and analyze. The stock market is the principal industry that takes advantage of this technology.

The stock market made the transition from paper transactions to electronic ones in the 1970s. Since then, the daily volume and complexity of financial markets have increased tremendously. Many institutional investors can now trade entire portfolios, or collections of securities and bonds, at one time.

The Metaphor Mixer was the first financial visualization application for VR. It was developed for Maxus Systems International in New York City. Reuters Select sends current financial information via satellite, which the Metaphor Mixer gathers and presents to the broker within a virtual environment in real time. The environment resembles a virtual football field. Grid lines divide companies into industry groups by category. The companies are further divided by market, such as the American Stock Exchange, Tokyo Stock Market, Hong Kong Exchange, Los Angeles Stock Exchange, and so on. This product is currently used by professionals rather than by consumers.

When using the Metaphor Mixer, the broker wears a head-mounted display (HMD) in order to become immersed in a simulation of the financial marketplace. An input device, such as a handheld wand or forceball, allows the broker to move through the simulation and access information about various companies.

Companies are represented by colored "poker chips." Each chip's color symbolizes a type of financial activity. For example, red chips indicate prices that have dropped since the previous day, blue chips signify a raise in price, and gray chips represent a stable price. The number of chips in a stack convey the relative trading price of the stock. Spinning and blinking chips represent selective criteria about each company that brokers can analyze.

Avatar Partners, located in Boulder Creek, California, offers the vrTrader for Windows-based financial visualization, for use by consumers and professionals. This application uses 3-D objects, real-time graphs, and text within its virtual environment. *Alerts*, which are visual and auditory cues,

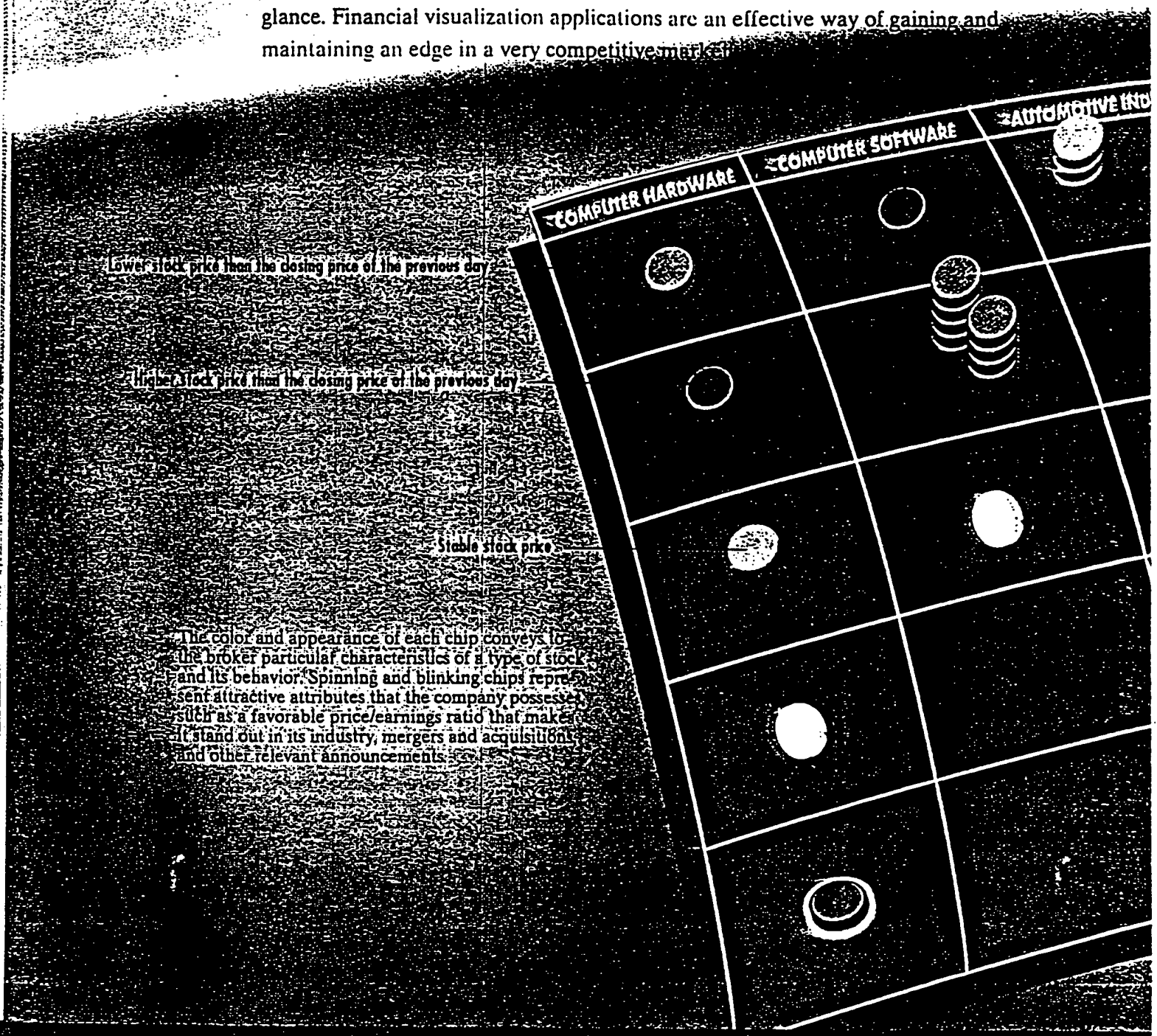
signal the user about significant events in the market. The color and behavior of objects changes according to important developments.

For a product like vrTrader to be useful, the flow of stock market data must be nearly instantaneous. In this case, a network control center transmits market information directly by satellite to FM radio or to individual satellite dishes for further broadcasting. A dedicated signal receiver box transfers current information to the user's computer.

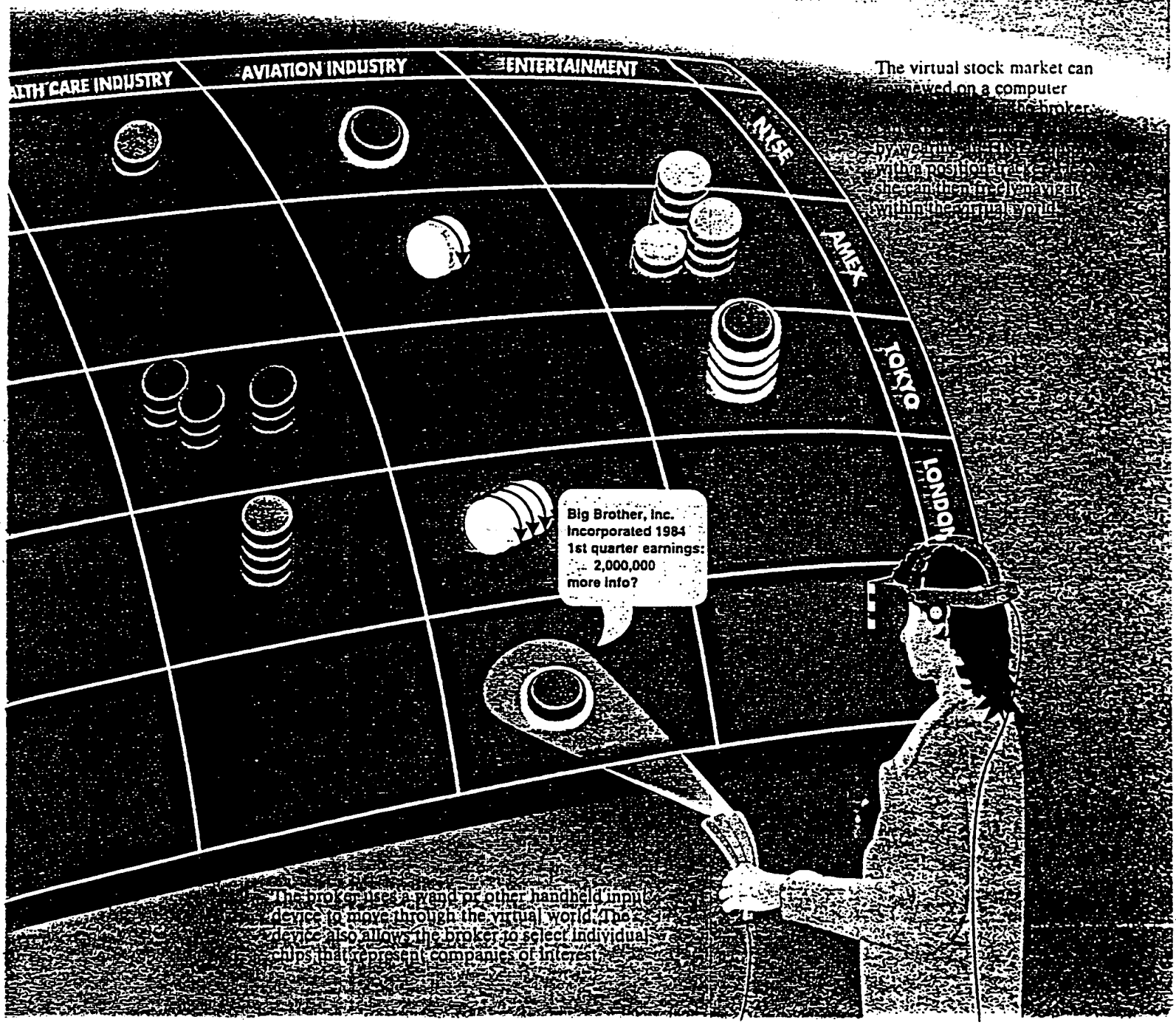
Small price variations between different markets such as the American Stock Exchange and the Tokyo Stock Exchange mean the difference between losing money and making a profit. Financial visualization applications are a viable means of accessing current data in an industry that changes by the minute.

The Virtual Stock Market

Virtual reality combines complex data about many stock markets into a single virtual world. A trader or broker uses stereoscopic shutter glasses or a head-mounted display (HMD) and an input device to enter and interact with this world. He or she can navigate through this simulation, detect relationships between stocks and markets, and absorb massive amounts of information at a glance. Financial visualization applications are an effective way of gaining and maintaining an edge in a very competitive market.



The Metaphor Mixer uses "poker chips" to represent companies in a simulated financial marketplace. The environment resembles a football field. Grid lines are superimposed over the field, separating one company from another.



The virtual stock market can be viewed on a computer [illegible] the broker [illegible] by wearing [illegible] with a position tracker [illegible] she can then freely navigate within the virtual world.

The broker uses a wand or other handheld input device to move through the virtual world. The device also allows the broker to select individual chips that represent companies of interest.

The Computerworld Smithsonian Awards

11A Mount Auburn Street
Cambridge, Massachusetts USA
02138-3704

Telephone: 617.349.3704
Facsimile: 617.349.3599

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Exhibit D

January 25, 1994

Mr. Paul Marshall
Maxus Systems International
25 Fifth Avenue
Suite 6F
New York, NY 10003

Dear Mr. Marshall,

CONGRATULATIONS! Your company's Metaphor Mixer has been nominated for a 1994 *Computerworld Smithsonian Award* in the Finance, Insurance & Real Estate Category. This nomination was submitted to the Awards Program by Intel Corporation. Enclosed is the Nominee's Kit, along with the program book from 1993 describing the awards program in detail.

It is very important that you:

- fill out and return **five** copies of the completed Questionnaire and
- submit **five** 35mm slides suitable for illustrating a short description of your outstanding use of information technology.

These materials are to be returned with the enclosed check list to the awards program office by **February 21**. Please feel free to call me at **(617) 349-3704** should any questions arise.

Your responses to the written Questionnaire become part of the Smithsonian Institution's permanent research collection – regardless of whether or not your nomination moves to finalist or winner status! Any optional materials you choose to include with the Questionnaire, although not be seen by the judges, will be reviewed by museum staff and considered for possible inclusion in the Smithsonian collection.

Once again, congratulations on being nominated! Please call with any questions.

Sincerely,

Alissa Perry
Program and Nominations Manager

Enclosures

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International Data Group
Mr. Gary Beach
Computerworld
Mr. Roger Kennedy
National Museum of American History,
The Smithsonian Institution

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02138-3704

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SEVENTEEN NEW YORK ORGANIZATIONS NOMINATED FOR 1994 COMPUTERWORLD SMITHSONIAN AWARDS

Industry Leaders Recognize Organizations Changing Society Through Technology; Cutting-Edge Technologies to Become Part of the Smithsonian Institution.

CAMBRIDGE, MA (March 23, 1994)-- The Computerworld Smithsonian Awards (CWSA) announced today nominations for its 1994 awards. Widely-recognized as the most prestigious awards program in the computer industry, the CWSA honors corporations, organizations and individuals who are changing society through innovative uses of information technology (IT).

See attached chart for a list of New York nominees.

Each nominee will become part of the Smithsonian Institution's permanent collection with the winners being placed on display in "The Information Age: People, Information & Technology," a permanent exhibit at the National Museum of American History.

Chairmen from 100 of the nation's leading IT companies nominate ground-breaking applications in 10 categories: Business and Related Services; Education and Academia; Environment, Energy and Agriculture;Finance, Insurance and Real Estate; Government and Non-Profit Organizations;

-MORE-

The Computerworld Smithsonian Awards

11A Mount Auburn Street
Cambridge, Massachusetts USA
02138-3704

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Manufacturing; Media, Arts and Entertainment; Medicine; Science; and Transportation. From this year's 279 nominations nationwide, an independent panel of three judges will select five finalists and a winner from each category.

"Looking at these applications, and the people who make them work, shows us that technology is an integral part of our lives," said David Allison, Curator of the Smithsonian Institution's Division of Computers, Information & Society. "Technology is a powerful tool, and the people who make these applications should be lauded for their immense contributions to society."

Finalists will be announced at the end of April and will be honored along with the winners at the sixth annual awards dinner at the National Building Museum in Washington, D.C., on June 6, 1994.

The Computerworld Smithsonian Awards attracts hundreds of nominations each year. Past winners have included life-saving medical advances, computer systems that enable disabled children to join mainstream classrooms, and programs that promote literacy and learning in urban schools.

Established in 1989, the Computerworld Smithsonian Awards were created to search out and publicly honor those men and women who are using information technology, across a spectrum of industries, to make our planet a more humane, healthy and cooperative place to live. In celebrating their achievements, the Awards help to demystify technology and empowers people to use technology as a tool for positive change.

###

1994 Computerworld Smithsonian Awards--NEW YORK

City	Nomination	Contact	Description
New York NY	Postscript-Based Publishing to produce *TheWall St. Journal* *Media, Arts & Entertainment*	Mr. Roger B. May (212) 416-2601 **Dow Jones & Company**	*The Wall Street Journal* electronically produces three editorial pages from a single location, then transmits them to 18 satellite printing plants. The electronic publishing system makes for mor einnovative layouts and speedier corrections.
	Nominated by: Adobe Systems, Inc.		

City	Nomination	Contact	Description
New York NY	**Global Market Data Distribution/Trading System** *Finance, Insurance & Real Estate*	Mr. George Shakespear (212) 648-9285 **J P Morgan**	J.P. Morgan's system provides a global network of stock and futures traders with real-time market information and news. The system facilitates the presentation and integration of information from thousands of different information sources, public and private.
	Nominated by: Booz Allen & Hamilton Inc.		

City	Nomination	Contact	Description
New York NY	**The Metaphor Mixer** *Finance, Insurance & Real Estate*	Mr. Paul Marshall (212) 777-8621 **Maxus Systems International**	Metaphor Mixer is the first commercial virtual reality to manage financial portfolios using live market information. Users feel as if they are swimming through an ocean of data. They can interact with a software agent that seeks investments based on user-selected criteria.
	Nominated by: Intel Corporation		

Press Release

Guggenheim Museum SoHo
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New York, NY 10012

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Exhibit E

VIRTUAL REALITY PRESENTATION ON VIEW IN THE LOBBY OF THE THE GUGGENHEIM MUSEUM SOHO

Media Open House: Tuesday, October 26, 1993, from 10:30 a.m. to 3:30 p.m., at the Guggenheim Museum SoHo, 575 Broadway at Prince Street, New York City

Symposium: "Art after Virtual Reality", Wednesday, October 27 at 6:30 p.m., at the Guggenheim Museum SoHo, 2nd Floor

A presentation of virtual reality, a computer medium designed to immerse the viewer in an artificial world, will be on view in the lobby of the Guggenheim Museum SoHo from October 23 through November 1, 1993. *Virtual Reality: An Emerging Medium* will be the first presentation of its kind at an American art museum and will offer a view towards the future of this new technology and its cultural impact. Although virtual reality is still in its infancy, its applications have already begun to affect a broad variety of disciplines including the visual and performing arts. This installation, which will suggest a number of future directions for this emerging medium, will feature five separate virtual reality "worlds" displayed on personal computers, three of which will be making their public debut. Contemporary artist Jenny Holzer and recording artist Thomas Dolby are among the many creative minds involved in these projects. This presentation has been developed in conjunction with the Intel Digital Education and Arts program.

Visual art in the last two decades has seen a widely increased use of computer technology as a medium. Virtual reality has been evolving from its current but still rudimentary form since the late-1980s, offering artists creative possibilities previously unavailable and unimagined through other digital media already in use, such as video or computer graphics. One factor is its immersive nature. A viewer wears a headset that displays a computer-generated environment. With a turn of the participant's head, a sensor on the headset adjusts to sustain the visual illusion of being inside that environment. Virtual reality is also interactive. In some worlds, the viewer may also interact with virtual "objects" and characters and even meet a graphical representation of another viewer.

Contemporary artist Jenny Holzer, best known for her computerized L.E.D. (light-emitting-diode) signs and other language-based works, has recently turned to the medium of virtual reality with the assistance of Sense8 Corporation of Sausalito, California. One available world will be Holzer's first virtual artwork, an untitled piece which features a cavernous world in which souls alternately flee from and engage the viewer. Viewers may also select Holzer's latest virtual artwork, which offers a response to the current political situation in Bosnia. Voices of the perpetrators, victims, and witnesses of rape and murder inhabit a cluster of dwellings in a stark and mutable landscape. The viewer may choose to wander from house to house collecting the testimonies or to seek the solitude of the perimeters of the village and its austere surroundings.

Another personal computer features the work of recording artist Thomas Dolby and co-developer Eric Gullichsen, who have created the first interactive artworld to synchronize animated figures with three-dimensional sound, resulting in the illusion that various sounds are coming from different points in space. In the *Virtual String Quartet*, viewers find themselves in a rehearsal space where a string quartet plays Mozart's *Quartet no. 21 in D Major*. Moving to a different location in the room shifts the sound accordingly, so that the cello sound always appears to come from the cello, the viola sound from the viola, and so on. More adventurous viewers who interact with a player will send that musician into an improvised jazz or bluegrass solo, which may or may not blend into its classical accompaniment. The music in this world is performed by *The Turtle Island String Quartet*.

The fourth world available to viewers will be *The Networked Virtual Art Museum: The Temple of Horus*, developed by Carl Loeffler and Lynn Holden at the Studio for Creative Inquiry at Carnegie Mellon University. This display is the first exploration of how virtual reality could be used to create a new type of museum experience. Based on the model of a computer network, this new museum would be simultaneously accessible to people at different points on the globe, and would use virtual reality to allow the viewer to "move" around within this artificial space. In this prototype, viewers find themselves in a virtual museum lobby where a portal leads to a

reconstruction of a 4000-year-old Egyptian temple to the god Horus. The hieroglyphics and statues encountered by viewers tell stories of the god and related rituals. Because two different personal computers will be connected by a network, viewers will see representations of each other walking around in the temple. This project is an example of the promise virtual reality has for the field of education.

Financial analysis is the subject of the fifth world, *The Metaphor Mixer*. This virtual stock portfolio, conceived and designed by Maxus Systems International, takes advantage of virtual reality's capacity for depicting abstract space to create a visual language for ten different investment variables. The result lets viewers feel as though they are swimming through an ocean of data. Corporate logos rise and fall with their stock value and special opportunities and risks are highlighted. The user can also interact with a software agent that will help hunt out interesting companies based on various investment criteria.

Those interested in experiencing this virtual reality presentation must request a ticket--good for one 10-minute training and viewing session--with the purchase of an admission ticket to the Guggenheim Museum SoHo. Requests for virtual reality tickets after the admissions ticket has been issued will not be honored. Because availability is limited, each ticket is only valid for one viewer at one station at one time slot. Tickets will go on sale at 11:00 a.m. each day for time slots from 11:10 a.m. to 5:50 p.m. on Sunday, Monday, and Wednesday, and for slots up to 7:50 p.m. on Thursday, Friday, and Saturday. The museum is closed on Tuesdays.

All of the virtual worlds in this presentation have been developed in collaboration with the Intel Digital Education and Arts (IDEA) program. The goal of the program is to inspire new uses for personal computer technology by creating partnerships with artists and educators who are developing new ways to use this medium for learning and artistic expression.

A symposium in conjunction with this presentation, "Art after Virtual Reality," will be offered in the Guggenheim Museum SoHo on the 2nd Floor on Wednesday, October 27, 1993 at 6:30 p.m. The panel will speculate on the impact that virtual reality and its promise of interactive networked experiences might have for art, music, literature, and museums. To order symposium tickets by phone (by credit card only) and for further information, call 212 423 3664 Monday through Friday from 10:00 a.m. to 5:00 p.m.

Also on view at the Guggenheim Museum SoHo this fall are *Paul Klee at the Guggenheim Museum* (through November 5) and *Singular Dimensions in Painting* (through November 15). The Solomon R. Guggenheim Museum uptown features a full-scale retrospective of the work of American Pop artist Roy Lichtenstein (October 8, 1993 through January 16, 1994).

Evening hours at the Guggenheim Museum SoHo and the Solomon R. Guggenheim Museum provide a convenient after-work option. The downtown location is open from 11:00 a.m. to 8:00 p.m. from Thursday through Saturday and from 11:00 a.m. to 6:00 p.m. on Sunday, Monday, and Wednesday (closed Tuesday). Viewing hours have also been extended at the museum uptown, which is open daily from 10:00 a.m. to 8:00 p.m. (closed Thursday). On Mondays between October 18 and November 1, and on January 10, the museum will close at 6:00 p.m. On Monday, November 8, the museum will close at 3:00 p.m.

END

#631
October 13, 1993
FOR FURTHER PRESS INFORMATION: Heidi Rosenau, 212 423 3840/1/2.

Exhibition: *Virtual Reality: An Emerging Medium*
Guggenheim Museum SoHo
Dates: October 23 - November 1, 1993
Image from *The Metaphor Mixer*
Created by: Paul Marshall, Maxus Systems International
Viewers can fly through a virtual stock portfolio that illustrates a variety of investment information, and interact with a software agent that helps them make an analysis.

GUGGENHEIM MUSEUM

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Exhibit F

VR explores new territory at the Guggenheim Museum, from rehearsing a Mozart quartet to bringing museums to people to analyzing financial data

by Sara Hedberg

VR Art Show at the Guggenheim

Virtual reality (VR) has captured the public imagination. That's the good news and the bad news. The bad news is that VR is finding its way into such misbegotten television shows as a *Murder, She Wrote* episode aired last year. The good news is that the Guggenheim Museum in New York City hosted an impressive VR show last October to showcase some imaginative possibilities for the technology.

The show, entitled "Virtual Reality: An Emerging Medium," was the first VR presentation of its kind at an American art museum. It was a joint project of the Guggenheim and the Intel Digital Education and Arts (IDEA) program (Santa Clara, Calif.). IDEA is designed to inspire new uses and users of computer technology. Exhibit goers, ranging from kids to septuagenarians, experienced five virtual worlds that showcased some highly creative uses of VR on Pentium-based 60 MHz PCs. Viewers were treated to a good dose of VR gear: Virtual Research (Santa Clara, Calif.) EYEGEN viewing devices, Polhemus (Colchester, Vt.) trackers, and Kraft (Vista, Calif.) Thundersticks. Behind the scenes, SPEA Fire boards performed high-speed graphics rendering.

Three of the five worlds in the show were artistic, one was a networked virtual art museum, and the last was a financial data management system. I'll describe all five and examine the financial VR application because of its implications for virtual data navigation and mining.

THREE ARTISTIC WORLDS

Music aficionados stepped into the Virtual String Quartet world and found an ensemble rehearsing Mozart's *Quartet No. 21 in D Major*. Moving to a different location in the room concomitantly shifted the sound, adjusting the participant's perspective. Viewers also could interact with any musician, sending the player into an improvised jazz or bluegrass solo, which might or might not blend into its classical accompaniment. The Virtual String Quartet, developed by Thomas Dolby (a musician) and Eric Gullichsen (a

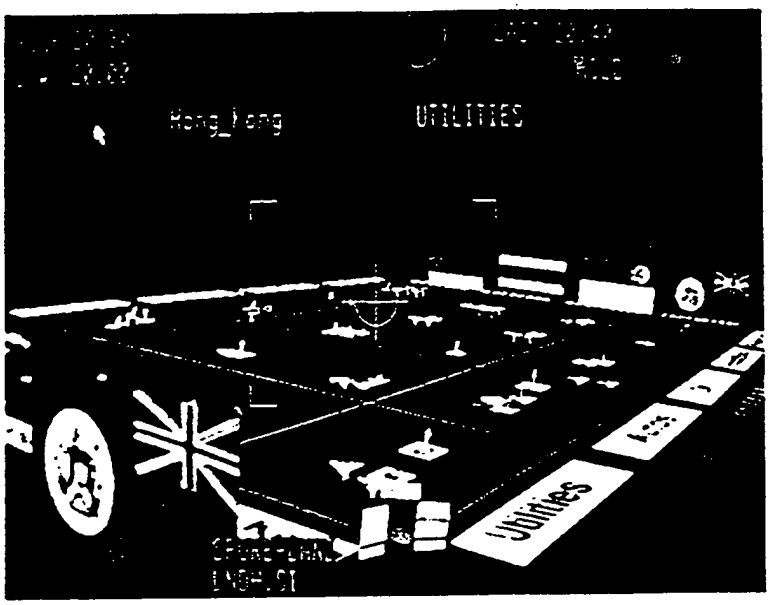

FIGURE 1. The Metaphor Mixer, created by Paul Marshall (Courtesy of Intel Corp.).

founder of Sausalito, Calif.-based Sense8), is an interactive art world synchronizing animated figures with three-dimensional sound, resulting in the illusion that various sounds are coming from different points in space.

The other two art works were executed by Jenny Holzer. Working with VR vendor Sense8 and its product WorldToolkit (WTK), Holzer's first piece featured an ethereal world in which souls alternately flee from and engage the viewer. On a more topical note, Holzer's second world took participants to Bosnia. Voices of perpetrators, victims, and witnesses of rape and murder inhabited a cluster of dwellings in a stark and mutable landscape. Viewers could wander from house to house collecting testimonies or seek the solitude of the village's perimeters.

MUSEUM WITHIN A MUSEUM

The fourth world at the exhibit, "The Networked Virtual Art Museum: The Temple of Horus," explored how VR can help create a new type of museum experience accessible simultaneously to people at different points on the globe. Based on Carl Loeffler and Lynn Holden's work at the Studio for Creative Inquiry at Carnegie Mellon University (CMU) (Pittsburgh, Pa.), the world begins with the viewer in a virtual museum lobby where a portal leads to a reconstruction of a 4,000-year-old Egyptian temple to the god Horus.

This project has tremendous implications for education. Imagine an Egyptian world with monuments and talking statues, for example, that relate information about the culture and rituals. In a separate project, Norwegian Telecomm (Oslo, Norway) has funded Loeffler's team at CMU to build an ancient Viking village world. The vision is to link up schools and let students visit this virtual Viking village.

DATA NAVIGATION WORLD

At first glance, the world of financial trading and portfolio management seems anomalous at the Guggenheim. "In fact, it represents industrial design as an art form where art and functionality meet," says Kevin Teixera, Santa Clara, Calif.-based Intel VR project manager. It also represents an innovative and potentially explosive application of VR to data-intensive problems.

This world, called the Metaphor Mixer, lets financial managers simultaneously visualize thousands of stocks on international exchanges, see market trends, and identify investment opportunities using real-time financial data feeds. The world lets users navigate the data and interact with it in real time, spotting trends and opportunities.

Traders face information overload; the average trader may be responsible for keeping tabs on more than 1,200 issues at any moment. If they work in the international marketplace, they need to watch Frankfurt, Tokyo, Hong Kong, Singapore, and others. The winners spot trends and opportunities first. In this cut-throat world of high finance, the race is on for new technologies to aid traders in using all available data to advantage.

Enter Paul Marshall of Maxus, a New York City-based financial consulting company. Marshall is the first to harness VR as a means to visualize, navigate, and mine these vast seas of rapid-fire data. Working with a small, select clientele, Marshall and his team have developed the Metaphor Mixer.

The Metaphor Mixer world looks like a playing field sectioned into rectangles (Figure 1). Viewers can fly through a virtual stock portfolio that illustrates investment information and interact with a software agent that helps them analyze it. Users can set up the world to monitor whatever stocks, exchanges, and trends are of interest. They may start, for example, by defining the x-axis of the grid as industry groups (aerospace, automobile, finance, utilities, and so on); the y-axis might be stock exchanges (Tokyo, Singapore, Frankfurt, Hong Kong, and so on). Thus, one rectangle might represent Frankfurt/financials, and another Hong Kong/utilities.

Within each rectangle are "chips," small colored geometric shapes that indicate a specific stock within an industry group. Users might even associate the company logo with the chip. The relative position of the chip; that is, how far above or below the surface of the playing field it is positioned, tells users how far up or down the stock is trading relative to the rest of the market that day. The shape and size of each chip represents capitalization of the company. The color of each chip is important—red indicates the stock is down from the day before,

blue that it is up, and gray that [redacted]e change occurred from the previous day. In addition, an arrow on each chip points up or down, indicating the chip's direction. Thus, you could have a red stock, with an arrow pointing up because the stock is on an upward trend.

Then, there is also the movement of the chips. Spinning chips can mean a stock has very attractive earnings, dividends, or financial ratios. Out of a field of 1,000 stocks, for instance, you might see 10%–15% of the chips spinning, or they might be blinking to identify a lucrative investment opportunity —such as an undervalued stock—that has cropped up. Financial managers look for the blinks and spins based on the parameters they have set. They then can zoom in on a particular individual stock and, in a regular text-based window, get specifics about the stock.

The net result is an abstract virtual world of ever-changing three-dimensional geometric shapes representing the moment's complex market dynamics. But users must get used to this new lexicon to comprehend and use the system fully.

HOW IT WORKS

To set up the world, users build a textual configuration file. Ten dimensions can be set in the world: *x*, *y*, and *z* axes, space, texture, arrow vector, blinking, spinning, color, and an intelligent agent. This intelligent agent, which Marshall calls a "profit-seeking missile," can scout and mine the world for any user-specified condition. One client has hooked the agent up to a neural network output to find trends requiring further investigation.

Metaphor Mixer is based on the Sense8 WTK VR software package. Sense8 spent about 100 hours working with Maxus, adding additional functionality to WTK and helping with the application. Intel lent some additional assistance to this project, seeing this application's new use of VR technology. The world redraws itself 10–30 times per second, depending upon the factors being followed, the activity level of the market, and, of course, the power of the computer and graphics rendering. Since Metaphor Mixer does not take you on a flight through real terrain, but rather concepts, the redraw rate is fine for users, according to Marshall. The biggest world represented with Metaphor Mixer to date includes 2,000 stocks, each stock being composed of two to three polygons.

The Metaphor Mixer dovetails with Maxus's other product, a real-time portfolio management system called Capri. This Windows-based server feeds real-time data and financial analytics into the VR engine. When users zoom in on a specific stock, they are unknowingly looking at Capri.

The system can run on a Pentium or 486 machine with a SPEA graphics board. While the system can be used with a head mounted display (HMD), as seen at the Guggenheim, Marshall says Maxus would be laughed off Wall Street if it tried to deliver an application with an HMD. Instead, their clients see the three-dimensional world on a 20-inch NEC/Hitachi monitor. Flying through this abstract stock market is accomplished with either a joystick or space-ball input device.

The software took 18 months to develop, and Maxus is in the process of unbundling it. Not surprisingly, this innovative approach is meeting resistance in the conservative financial sector that is accustomed to spreadsheets. The natural human resistance to change is also a factor. Nevertheless, there are whispers of other financial institutions, such as Barclays Bank and Chemical Bank, experimenting with VR.

IMPLICATIONS

Using VR as a database navigating and mining tool has many implications. The most obvious is that the day is not too far off when individual investors may have similar functionality available as more computing horsepower at less cost becomes available. More profound are the implications for a range of data-intensive applications—with or without real-time data feeds. Such an approach could be used for inventory control management at an auto factory, for example. Groups as disparate as the CIA, FCC, military, legal, sports, medical diagnostics, and chemical research have all expressed interest in using such tools.

Intel's IDEA program and the Guggenheim exhibit are good news for the VR industry, because these efforts will help promote and educate the marketplace. Moreover, the exhibit not only shows that desktop VR is possible, albeit a $10,000–$20,000 proposition, but it also shows that VR technology, when put into the hands of creative people, is an exciting new computer interface medium offering tremendous possibilities to the artistic and business worlds.

Will this exhibit make it to your city? Probably not, according to Intel's Teixera. But other projects are in Intel's hopper, so stay tuned. ☆

Sara Hedberg is president of Emergent Inc. (Issaquah, Wash.) and specializes in the analysis and marketing of emerging computer products and technologies. She writes for *Byte*, *AI Magazine*, and other publications and is the former editor of the *Spang Robinson Report on Intelligent Systems*.

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Here's a new sci-fi investment tool that makes spotting and tracking securities quicker, easier and more fun.

Cyberspace meets Wall Street

By William G. Flanagan

THE 3-D universe of virtual reality—the computer technology that creates artificial worlds in which to work and play—is coming to Wall Street.

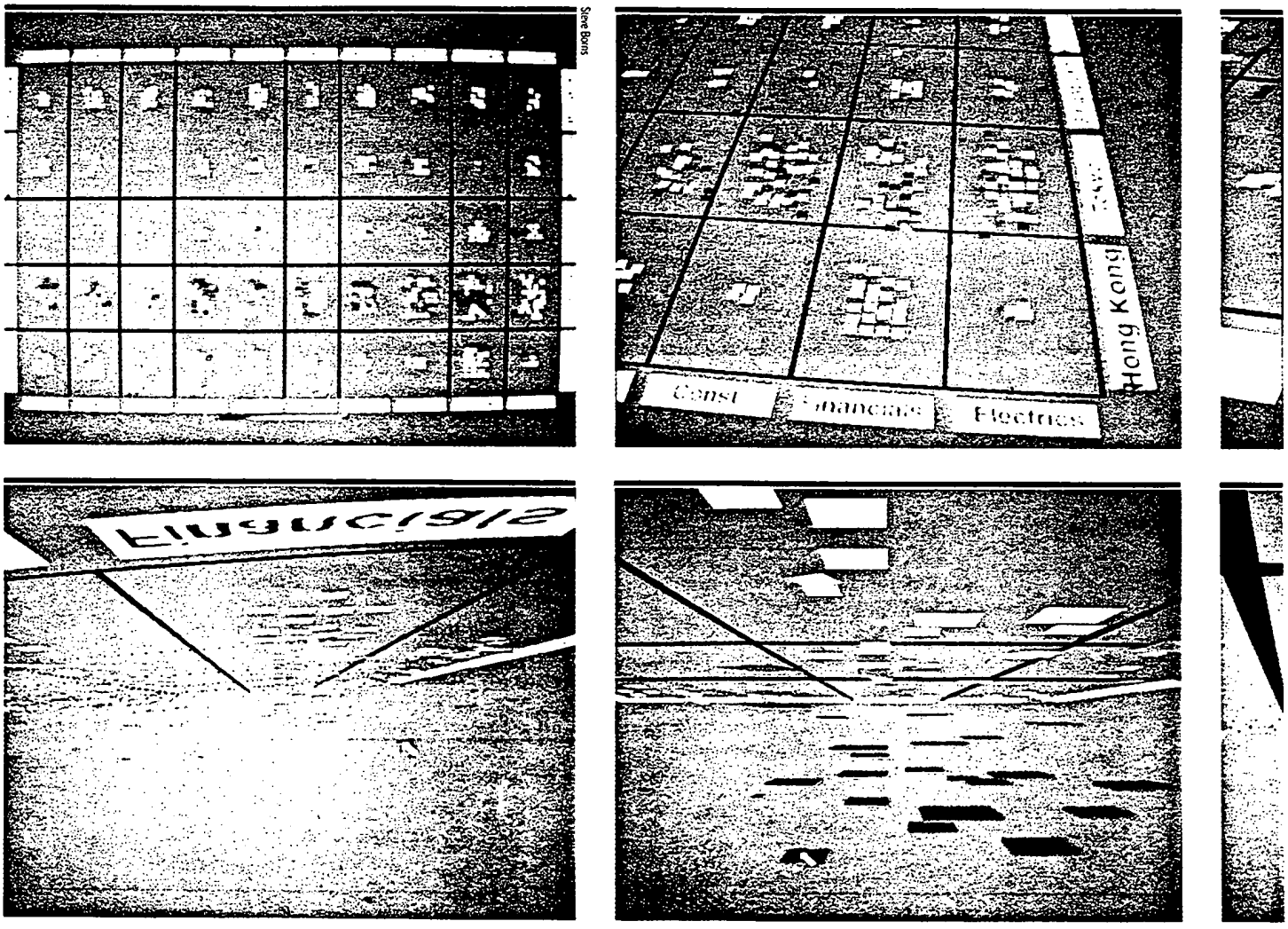
Picture this. You are sitting at your computer screen, looking down at a football field, as if you're sitting in the press box. But you are not stuck there. With your Spaceball control you can fly into the screen—cyberspace—and swoop over, down to, and even through the field below.

But the gridiron below has no players. Instead, it is marked off into rectangles. One side of the grid lists industry groups—financials, utilities, automotive, electricals, paper and pulp, and so on. The other sideline indicates various stock exchanges—Tokyo, Hong Kong, Singapore, Thailand and so on. So Tokyo/financials is one rectangle, and Hong Kong/utilities another.

In each rectangle there are small, differently colored chips, some of which are spinning and blinking. Each chip represents a stock in a particular industry group, on a particular exchange, on a particular day. Let's take Apr. 8, 1992, a very, very bad day for the Pacific markets; Tokyo crashed 3.5% that day.

Amid the sea of red chips spread out on the grid below, there's one especially bright one, blinking near the goal line. And over here, near the out-of-bounds marker about midfield, is a bright blue chip that is spinning. All over the field are hundreds of other red, blue, brown and gray chips.

The colors tell you something. Red, for instance, means the stock is down from the day before; blue, that



the stock is up; gray, only marginally changed. On this Apr. 8, the screen looks like a field of poppies. The movement, if any, tells you something, too. If the chip is spinning, it has very attractive fundamentals, such as a lower price/book or price/earnings than other stocks in its industry. If it is blinking, attractive arbitrage possibilities have cropped up in the security's options or warrants.

Relative position of the chips is important, too. How far below or above the surface of the playing field tells you how far down, or up, that stock is trading relative to other chips.

Say you want to investigate further. Using the Spaceball, a sort of 3-D mouse, you leave your eagle's perch, swoop down from the press box and fly through cyberspace, onto and underneath the grid below. The chips are closer and much larger in size, now, as you narrow your field. You pick that red, blinking chip in the Tokyo/financials rectangle. From beneath the grid you can see that this chip is down more than any other in its sector.

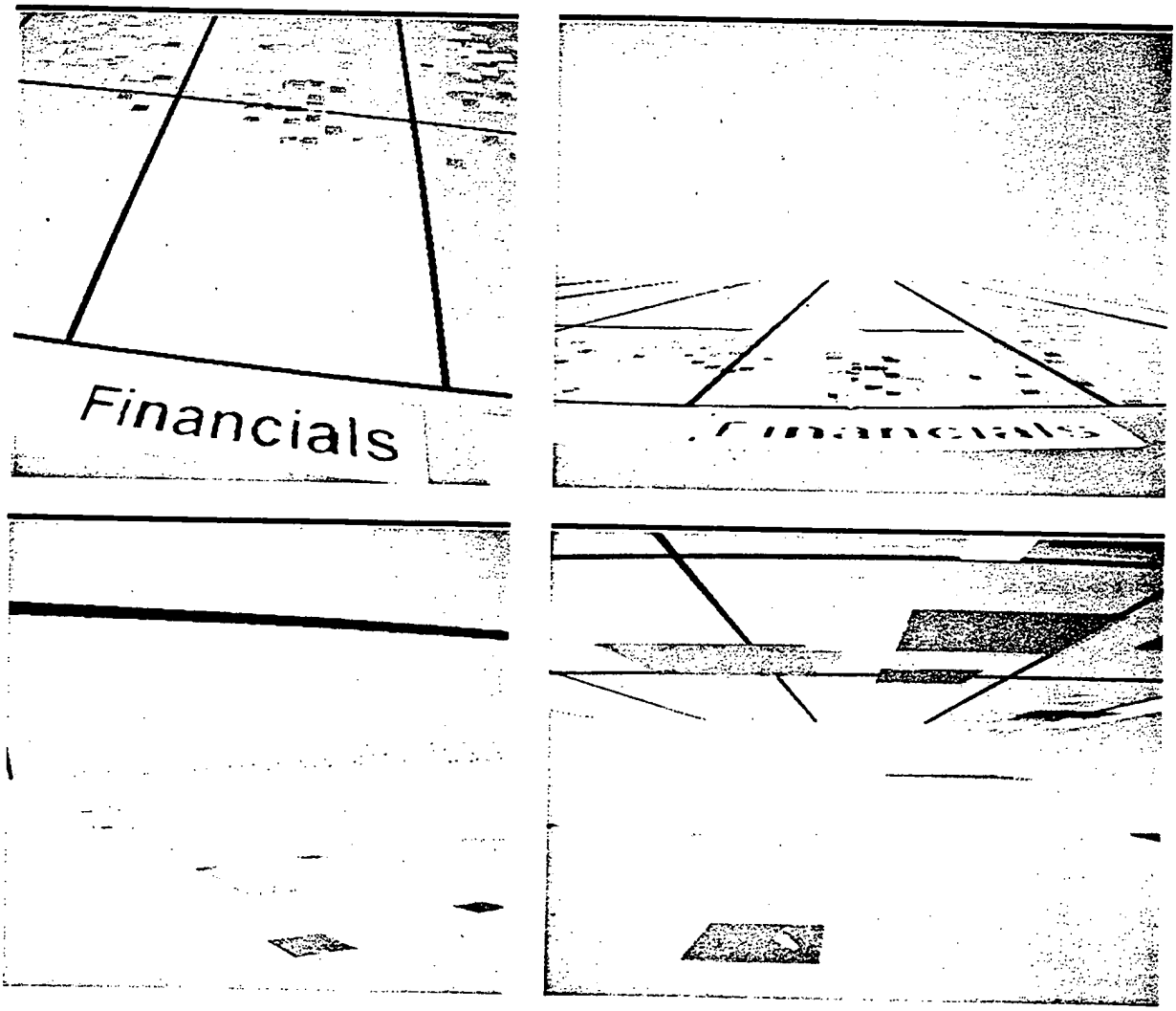
A click of the mouse makes your computer switch gears to conventional characters. The screen tells you the name of the stock and supplies you with particulars. The red chip is Ashikaga Bank, which has dropped an astonishing 15% in a single day.

What's going on here? Computer graphics—in this case 3-D graphics—are being used to give you an animated picture of more data than you could ever absorb from a spreadsheet.

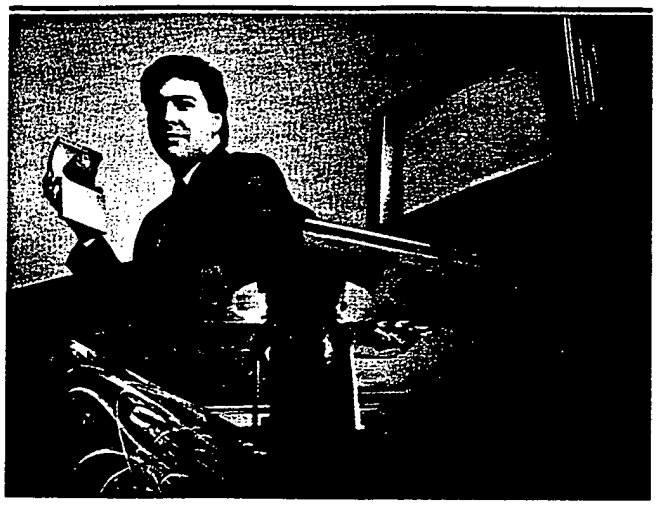
The above example is not an experiment; it is now in place at TIAA-CREF, the $106 billion college teachers' pension fund. Money managers there use the system, called Capri, to track Pacific Rim stocks and markets, although other stocks and markets could also be tracked in the same way. In fact, Capri can be designed for any portfolio. And if you don't like the metaphor of a grid with colored, spinning, blinking chips, you can design another one.

This new world of data visualization is not yet available to the small investor. But, thanks to the rapidly shrinking prices of hardware, the day when it will be available is not far off. Capri runs on a 50-megahertz 486 computer. That's a lot of horsepower by today's desktop standards, but it will be garden-variety within a few years. In the meantime, the individual investor has access to a variety of trading programs that use 3-D visualization and other graphics techniques *(see box, p. 168)*. The concept here is the same as with Capri: to capitalize on the fact that the brain is much better equipped to grasp data presented visually than data presented as numbers and text.

The Capri system is the brainchild of Paul Marshall, 29, executive direc-



Pacific Rim stocks in virtual reality **Each chip is a stock, which you can home in on and identify. This red loser is Ashikaga Bank, Apr. 8, 1992.**



Maxus Systems' Paul Marshall **Using Spaceballs to track stocks through cyberspace.**

tor of Maxus Systems International, a New York-based financial consultant. Marshall discovered the power of graphics in an early TIAA-CREF assignment to help traders sort through Japanese warrants and convertibles. These derivatives can be valuable hedging tools to pension fund managers, but to handle them the trader needs to juggle live price data coming against convertibility formulas and assumptions about volatility for each security.

Instead of seeing rows of numbers, money managers using an early version of Capri got to see colored graphical displays for each security. They looked like aerial photos of alluvial flows, but to the practiced eye they delivered a lot of critical information in a trice.

Marshall then wanted to pack even more information onto the pictures on his computer screen, and to allow managers to fiddle around with that information. Enter a gritty science fiction novel called *Neuromancer,* by William Gibson. This 1984 thriller introduced millions, including Marshall, to the then arcane world of virtual reality. Bells went off. Gibson's computer-generated cyberspace provided all the 3-D elbow room Marshall needed to graphically display the data he wanted. And what's more, it created an artificial world that could be cruised through and manipulated by money managers.

Late last year Marshall went to Sausalito, Calif. to visit Sens8 Corp., a young software company that makes and markets WordToolKit—a library of C language routines that programmers use to create customized virtual reality environments. After a few months of sweating, and with the help of the folks at Sens8, Marshall had the Capri virtual reality system up and running.

How effective is it? Like any tool, only as good as the skills of its operator. But in the right hands it gives a good money manager an edge in interpreting and manipulating investment information. Marshall is now exploring ways to market the system elsewhere on Wall Street.

He's got to work quickly. A technological edge in investing doesn't last very long these days. ■

Visual investing

IT WILL BE a while before virtual reality reaches the ordinary investor's personal computer. But already there are off-the-shelf programs that use graphics and color to give the investor a lot of information at a glance. Here are three hot items—all are aimed at technical traders.

AIQ TradingExpert, from AIQ in Incline Village, Nev., is a dandy program for the trader with a hefty portfolio—and it's priced to match, at $1,000 list. Like low-end computer investment programs *(see following story)*, it charts whatever companies are in your portfolio. It includes an assortment of built-in technical indicators that tell you about relative strength, volume trends and other favorites of chart-watchers.

AIQ allows you to course through past charts and back-test new hypotheses. The charts use color to indicate strength and weakness of securities.

Mesa Co. in Goleta, Calif. has a program called 3D. The program charts five fairly arcane indicators called stochastics, relative strength, moving average convergence and divergence, double moving average and parabolic stop and reverse.

The three-dimensional chart looks like a glacier with humps and mounds, coming right at you. It tells the experienced eye something sheer numbers won't. A smooth patch in the glacier, for example, means that the particular indicator you are looking at—say, a moving average—has little sensitivity to big variations in the market. The program also helps the technical analyst create and fine-tune his theories. Price: $199.

From Traders Insight, in Huntington, N.Y., comes Auto-Candle. It uses so-called Japanese candlestick patterns to chart stock and commodities movements. Candle charting began 200 years ago in the Japanese rice markets. At a glance, it tells you five things about the daily movement of a stock or commodity. The body of the candle represents the open and close for the day. The candle has wicks at both ends, which give the high and low for the day. If the security closed higher than it opened, the body of the candle is left blank; if it closed lower, the body is in color. If you string a bunch of these candles together, certain trading patterns emerge. Auto-Candle spots these patterns for you. Price: $195.

Technical analysis is an occult science that pays more attention to past price changes in a stock than to its present value. It's hard to get rich being a technician, but if you want to try, you might as well have the best equipment. Put away your pencils and graph paper.

–VICKI CONTAVESPI ■

The goal for automating financial systems is really quite simple: to minimize risk while maximizing profitability. AI excels in this area

by Jessica Keyes

AI Lives Another Day on Wall Street

Black Monday in 1987 dampened enthusiasm for more than just the stock market. It also put the kibosh on R&D—particularly anything AI-related. But that was a long six years ago, and, if anything, the stock market has rebounded beyond even the unprecedented records set in the 1980s.

Financial services is more than just Wall Street. A synthesis of three industries—securities, insurance, and banking—financial services dwells in the rarefied world of high finance. Credit. Loans. Underwriting. Trading. The goal for automating systems of this ilk is really quite simple: to minimize risk while maximizing profitability.

This is exactly what AI is good at, so it will come as no surprise that the 1980s saw quite a few AI-infused systems built, from foreign exchange systems to money transfer; from real estate appraisal to financial planners. From NERSys, a claim processing system for Blue Cross and Blue Shield, to Peat Marwick's Loan Probe, the proverbial "Street" was paved with gold for the AI-enriched. So what happened? Where did it all go?

A RETREAT FROM RESEARCH

Roy Freedman is president of New York City-based Inductive Solutions. Formerly a professor at Polytechnic, Freedman now chairs the AI on Wall Street conference that is jointly sponsored by IAKE and Smart F$ (more on them later). According to Freedman, "What's interesting, in our wonderful recessionary economy, is that research has all but vanished."

According to Freedman, many of the heavy hitters in AI vanished as more and more budgets were sliced and R&D groups eliminated. Freedman explains it this way: "Look at AI in the context of technology and innovation in general. In the 1980s there was a big interest in creative problem solving. Now there's only interest in staying alive."

There seems to be an "if it isn't broke, don't fix it" mentality afoot. Freedman offers this interesting example: In the early 1960s, the federal government developed a

system to keep America safe from thermonuclear war. Named the Worldwide Military Command Control System, or WWMCCS, it was run from a deck of cards. When systems engineering advanced a notch or two, it was suggested that WWMCCS be rewritten to take advantage of the newer technologies. The government declined. If it's not broken . . .

One has only to look at the papers presented at the AI on Wall Street conference to see the truth in Freedman's comments. In 1991, there was a lot of emphasis on research, but in 1993, there was more emphasis on practical applications such as asset allocation. This was also true for the April conference on "Applications of Expert Systems and Neural Nets in the Financial Field" that took place in Milan. Here the list of speeches reads like a litany of the very ordinary: an expert system for advice on landowner credit, an intelligent assistant for compiling monthly economic data, and an expert system for evaluating credit worthiness in a Swiss bank.

Maybe that's not all bad.

THE COMMODITIZATION OF AI

Although Freedman is pessimistic on the fate of AI R&D in recessionary America, he's much more optimistic when talking about practical uses of AI. Freedman's company, Inductive Solutions, markets three tools that are popular with the Wall Street crowd. CASE Power is a case-based reasoning tool, BRAIN Power is a tool set of neural network algorithms, and GENETIC Power is a tool for genetic algorithms. Interestingly, most of Freedman's customers are users, financial analysts, and traders, rather than AI-ers, and few of them realize that AI is involved. As Freedman puts it, "Is it really AI if the technology is part of the mainstream?" Since Freedman's products can run as part of a spreadsheet, his question is thought-provoking.

Is AI a commodity? Many AI vendors are trying to mold the market in just that way. Look at AION and AICorp. Now merged as Trinzic, they do not tout their AI roots at all. Rather, AI is just additional "intelligence" that their business process reengineering product happens to sport—an intelligence that gives them a competitive boost over other competing products.

HNC's Michael Thiemann sees an evolution of AI from tools-oriented to solutions-oriented—especially in the financial services arena. When Thiemann, an executive vice president at the San Diego-based company, first came to HNC in 1989, he rigorously surveyed the AI market. "There were four industries that had difficult problems that couldn't be solved any other way: payment systems, mortgage market, database marketing, and the retail market," he says. Although HNC still markets its tools, particularly the DataBase Mining Workstation, Thiemann felt it would be far more lucrative to sell complete solutions instead.

One of these solutions goes by the name of Falcon. Several notable financial firms, including First USA Bank, Colonial Bank, and Wells Fargo Bank, have taken flight with this automated fraud-detection system. Falcon can be used for debit cards, medical payments, checking, or virtually any other payment transaction.

Based on HNC's Unified Decision Technology, Falcon combines advanced database capabilities, statistical methods, and neural network techniques to detect and flag abnormal transaction patterns. At Falcon's heart is a neural network model of cardholder behavior. It predicts the likelihood of fraud based on current and past transaction patterns. Fraud is such a major issue within the financial services community and Falcon is such a good solution that the product has received an overwhelming amount of press coverage in such journals as *American Banker*, *Fraud Watch*, and *Credit Card Management*.

What Thiemann knows, and other AI firms are rapidly discovering, is that the AI tool is just half the battle. To get Wall Street (or any other industry) in your corner, you must have the knowledge as well. This, according to Thiemann, is something that HNC now has in spades. "We have the world's experts in the fraud business," he says.

MORE THAN JUST HYPE

Citibank's Dan Schutzer would be the first to commend HNC's move to the business side of AI. In fact he and many other industry observers see this trend as more survivalist than anything else. Schutzer, along with being the director of advanced technology

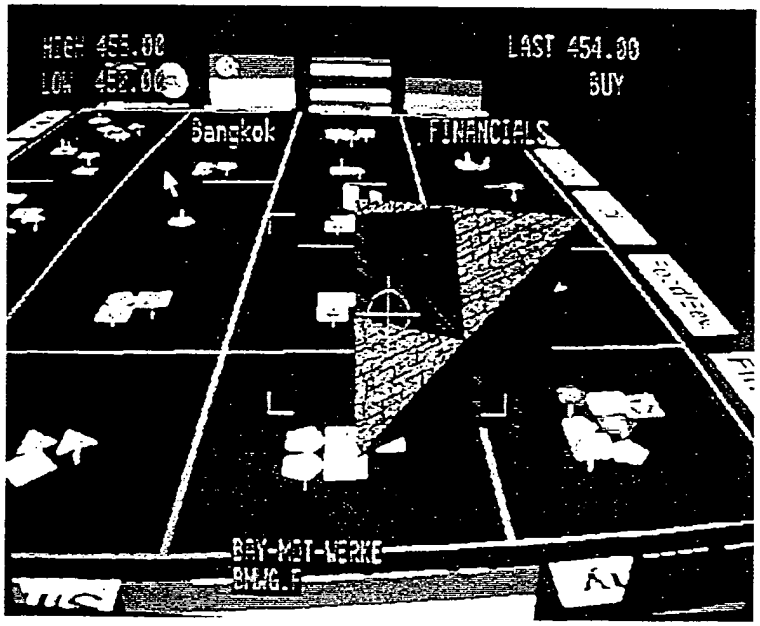


FIGURE 1. The Metaphor Mixer creating the Star Trek's holodeck of financial systems (Courtesy of Maxus Systems Int.).

at Citibank, is also the chairman of Smart F$ in New York.

When AI was still in its heyday on Wall Street, a few good people got together and decided to form a society of financial services industry people with an interest in AI (hence Smart F$: F$ stands for financial services). Meetings were held about every six weeks where AI-techies from diverse financial firms talked about yet another exotic AI application. Unfortunately, according to Schutzer, "A lot of it was hype"—the tools as well as the applications.

In 1987 the capital market systems group of a well-known brokerage decided to expert-systematize the art of choosing a hedging strategy. This, in case you're not privy to the world of high finance, is one of the most complex quantitative analytical tasks around. The heart of the hedge is the judgmental knowledge of the trader. With great fanfare, the Intelligent Trading System was announced. The company forgot one thing, though: Traders simply do not part with their expertise. Therefore, the "intelligence" in the Intelligent Trading System was reduced to what could be gleaned from the pages of a textbook. Hardly an "expert" system.

Today things have calmed down quite a bit. And if you go to a Smart F$ meeting, you'll likely hear not about trading applications but about help desks; not about financial advisors but about fraud systems. AI, in other words, seems to have embedded itself into applications where real-world knowledge exists.

EMBEDDED KNOWLEDGE

Catching fraud is big business, and a lucrative one, too. A good system can save a company millions of dollars a year. Neural nets, though, are only one way to catch a crook. Expert systems are good police officers, too.

Chemical Bank runs one of the largest international foreign exchange departments in the world. It needed to find a way to check the thousands of transactions that Chemical processes. Its solution was to build an expert system (called Inspector) using Neuron Data's Nexpert.

Inspector runs 24 hours a day across 23 international locations. Exchange information is loaded onto IBM mainframes and sent across a global telecommunications network to Chemical's foreign exchange VAX in New York. Stored in an Oracle database, after some preliminary processing for statistics and trends, the Nexpert module can begin evaluating the stored transactions using rules similar to this example:

```
If the dollar amount of a deal is greater than the
  average dollar amount
Then flag that transaction
```

According to David Rahn, Neuron Data's product marketing manager, "Before Inspector, Chemical's foreign exchange employees were faced with a tyrannical amount of paperwork." And paperwork begets errors, which loses the company money.

Rahn, like the others interviewed for this article, sees AI as part of the overall picture for financial services—not the center of attraction that it once was. "AI should not be stand-alone. It should be integrated with multimedia, databases. . . . You need a combination of technologies to solve tough business problems."

INTEGRATED AI

Probably one of the more exotic of these "combinations" is the fusion of AI and virtual reality (VR). When you add financial services to this mix, you get something rather extraordinary. Paul Marshall is the executive director of New York City–based Maxus Systems International. His stock in trade is a VR system for visualizing stock trading data.

Maxus has two products. One is called Capri and is a real-time, Windows-based portfolio management risk analysis and derivative analytic system. Capri collects a database on issues such as stocks, bonds, futures, and options, and uses a neural network to do all the analytics such as price to book and underlying options information.

Where Maxus becomes interesting, though, is when all this information is fed into what is euphemistically called the Metaphor Mixer. Let Marshall explain it. "The Metaphor Mixer gives you 10 embedded dimensions in one picture."

That's right—10. Where in conventional systems you normally get a measly three dimensions, the Metaphor Mixer has created the Star Trek's holodeck of financial systems. If you look at Figure 1, you'll see a checkerboard with four quadrants. But this is not a flat picture. "Inside this are different chips that look like poker chips, and they're floating above this checkerboard that we'll call ground zero," says Marshall. The holodeck is completely configurable. "The *Y* axis can be mapped into some variable, such as percent change in price, so a stock that has gone up a lot will be far above the grid glowing blue."

If you get right down to the level of the plane, the chips appear either above, below, or right on the grid. Therefore, the height and the color mean something. There are even corporate logos (of the stocks) mapped onto the grid, which can be turned on so that the VR-enabled investor can determine the name stock of interest's name.

Size, shape, color, position on the plane, blinking, and spinning are all visual clues to the investor. But there's also a tenth dimen-

sion, according to Marshall. "The tenth dimension is an AI software agent that the user can configure from our neural network output (Capri) or from a case-based reasoning system or even an expert system," he says.

Essentially what Maxus has invented is akin to a "Wargame" approach to the stock market. "When you select an issue, there's a head-up display such as a fighter jet that is telling you where you are in the world as you fly over it," according to Marshall.

Marshall is not an AI expert. Nor is he a VR jock. His background is in the area of international arbitrage. But he realized that managing a $2 billion portfolio with more than 900 stocks was too complex for a human to handle alone. So with his computer expert partner, he formed Maxus to create the Metaphor Mixer, or as he puts it, "the radar that will find the sunken treasure."

AI UNDERPINNINGS

Some would ague that despite a paucity of recent robust applications, advanced technology is still very much alive in the financial services world. One has only to look at the workstation arena. Since the early 1980s, banking and securities-trading firms have been the biggest users of workstations. Now Steve Jobs's NeXT is angling to get its NextStep operating system a shot at the Wall Street crown.

Chicago Research & Trading Inc. (CRT) was recently acquired by NationsBanc, the country's fourth largest bank. Why? One of the primary reasons was to give NationsBanc access to CRT's object technology, which is based on NextStep.

While some AI-purists would argue that object technology is a field apart from AI, there is no doubt that early interest in AI—which is itself largely object based—in turn fueled today's active interest for object orientation.

Frank Middleton is a partner in the Saddle Brook, N.J., firm of Advanced Methods, which specializes in the use of advanced technological solutions to business problems. When one of the largest banks in the world needed to build a productive and reliable solution to the funds transfer problem, Middleton went on a search to find the perfect tool with which he could implement the solution. The tool he picked, Hamilton Technologies' 001, is a new breed of object-oriented (OO) tool that combines superintelligence with robust systems engineering functionality.

"001 provided a complete functional description, a model of work plus the usable code. Other products did not," says Middleton. "001 is completely OO. In fact, it was probably one of the first (1987) OO tools available. It creates pieces of reusable code that are very logical and self-contained. 001 is the most comprehensive tool I've seen."

When Cambridge, Mass.–based Hamilton Technologies, Inc. set up shop in 1986, its mission was to create a suite of tools that would wrap around a new and unique methodology born of the space age. When HTI's founder and president, Margaret Hamilton, was director of software development for NASA's Apollo and SkyLab projects at MIT during the late 1960s and early 1970s, she began an empirical analysis of the massive amounts of information generated by these critical missions.

As a result of this analysis, Hamilton spearheaded an extensive effort to minimize software errors in future critical software projects. The result was the embryo of a theory of systems engineering and software development that, if used correctly, could be a way to eliminate most errors in a system before it is implemented. Twenty years and much research later, this embryonic theory has fully matured and has become the basic guiding principle of the 001 systems engineering and software development tool suite. This theory is known as "development before the fact."

Development before the fact is an intelligent paradigm that fosters productivity and reliability. "We fix most systems after the system has been implemented. This, in fact, is the reason our maintenance budgets often exceed our development budgets. Development before the fact is a way to make sure that errors are eliminated before the system is delivered by creating systems, building-block fashion, on a foundation of reusability and integration," says Hamilton.

001's heart is the 001 AXES language. Not a programming language, 001 AXES is a specification language that can be used to define real-world objects and their relationships. 001 AXES can be used successfully in all types of design tasks, programming and nonprogramming, because it uses both hier-

Some would argue that despite a paucity of recent robust applications, advanced technology is still very much alive in the financial services world

archical and networking structures simultaneously, which give it a structure natural enough to solve real-world problems.

A problem is defined as a series of interlocking and interconnecting function and type hierarchies. FMaps (function) and TMaps (type) are the hierarchical mapping tools that enable the designer to decompose a process into components that will naturally work together. 001 hierarchies provide a natural structure for controlling the network of intercommunicating functions that form the basis of any system.

001 uses its smarts to enable developers and engineers to generate systems automatically that run on any hardware or software platform, including graphical user interface, database, operating system, or programming language. Where 001 gets even smarter is in its ability to "track" specification flaws much like a divining rod tracks water. The 001 Analyzer automatically hunts down at least 75% of the errors normally encountered in development before implementation. It also tracks down all of the interface errors.

Another "smart" feature is 001's ability to simulate what the system is supposed to do. Not only can 001, through its Xecutor tool, simulate the current design, it can simulate abstractions of the design as well.

AI REDUX

Long gone are the days of AI for AI's sake. Today's financial services community has a different outlook as well. As Citibank's Dan Schutzer puts it, "If you think you're going to automate the stock ticker, you're wrong." AI, like other technologies before it, is just one more tool on the technological tool belt. And most of us wouldn't have it any other way. ☆

Jessica Keyes is president of Techinsider/New Art Inc., a technology consultancy/research firm specializing in productivity and high-technology applications. A past managing director of advanced technologies for the New York Stock Exchange, Keyes is the author of six books including *Infotrends: The Competitive Use of Information (McGraw Hill, 1993).*

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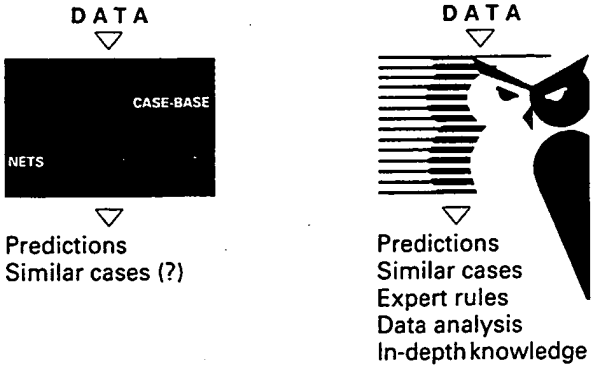

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Trust and Investments

ABD's Global Traders Test Virtual Reality

BY WILLIAM PESEK JR.

Edward Santalone

GEORGE M. GABRIEL, vice president of foreign institutional trading at ABD Securities, uses a virtual-reality system to follow more than 1,200 issues daily.

It would probably be safe to say that most bankers perceive "virtual reality" as little more than a New Age entertainment medium rather than a tool to be wielded in their buttoned-down professional lives.

But with an eye on the future, some investment banks are turning to this most rarified of high technologies to give them an edge in rapid-fire financial markets.

ABD Securities Corp., the New York-based securities trading arm of Dresdner Bank, for instance, is using a pioneering system that allows its traders to visualize data in animated, graphic form rather than on spreadsheets or in cumbersome reports.

Sort of the Apollo moon-shot of computer technology in the financial services business, the firm, with $235 million in assets, has decided to take one giant step forward with a data distribution and display system, called the Metaphor Mixer. The software, developed by New York-based Maxus Systems International, helps traders grasp otherwise unmanageable amounts of complex information.

"Seeing [graphic-oriented data] is faster and better than reading where real-time markets are concerned," said George M. Gabriel, vice president of foreign institutional trading at ABD.

The use of virtual reality on a trading floor is based on the premise that the brain is much better equipped to grasp data presented as three-dimensional graphics than as numbers or text. Traders access this information simply by pointing to a menu of symbols displayed on the screen.

Staying on top of the markets is key at ABD because the firm serves as a broker-dealer in numerous equity markets around the world and provides trading, execution, and clearance functions for global institutional and private clients.

Mr. Gabriel, like most international traders, is responsible for keeping tabs on more than 1,200 issues at any moment of the day. That means monitoring the movement of stocks from a whole slew of exchanges, including Frankfurt, Tokyo, Hong Kong, and Singapore.

Continued on page 22A

At a Glance

ABD Securities Corp., subsidiary of Dresdner Bank

Headquarters: New York
Assets: $235 million
Employees: 140
Hardware: AST Research Corp. 486 personal computer
Software: Maxus Systems International Capri and Metaphor Mixer virtual reality software
Microsoft Corp. Windows
Sense8 Corp. WorldToolKit

ABD Traders Get Jump on Markets with Virtual-Reality System

Continued from page 4A

Metaphor Mixer – which is installed at ABD using a personal computer from AST Research Inc., Irvine, Calif., with an Intel Corp. 80486 microprocessor – provides an electronic medium for simplifying large amounts of information. It also helps traders identify opportunities and discern the patterns and trends in financial markets.

"The level of detail the system offers is a significant step because of the kind of power and visualization it puts in the hands of traders," said Donald E. McNees, vice president and director of the New York financial services consulting practice at Towers Perrin.

"When those windows of opportunity open, they don't stay open for all that long," Mr. Gabriel said.

True to its roots, Metaphor Mixer looks like a cutting-edge video game. The screen is a jamboree of colors and shapes, each assigned with a different meaning. It is controlled by a hand-held device called a spaceball. But a glorified Pac-Man it's not.

How does it work? The screen gives sort of a bird's-eye view of a large playing field. The field is marked off into rectangles. One side of the grid lists industry groups – finance, paper, utilities, electricals, and so on. The other side is broken down into various stock exchanges. In each rectangle there are several different colored electronic poker chips, each indicating a stock in an industry group.

The colors of the chips are important. For example, red means that the stock is down from the day before; blue, that the stock is up; and gray, that the stock is little changed from the previous day.

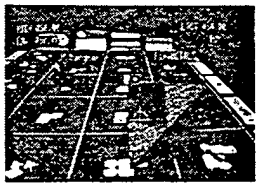
The movement of the chips is equally important. A spinning chip indicates that the stock has very attractive fundamentals. If a chip is blinking, some lucrative arbitrage opportunities have cropped up.

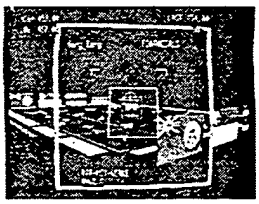
The next factor to watch for is the relative position of the chips. How far above or below the surface of the playing field tells you how far up or down the stock is trading relative to the rest of the market that day.

Traders can also get a closer look. Using the spaceball, the user can swoop down to the field or underneath it. Mr. Gabriel can get the name of an individual stock and all the particulars by clicking the spaceball on it.

"If things are hectic, I can look at the screen and get an instant perspective," he said.

As far as industry observers are concerned, the jury is still out on virtual-reality trading systems. "Most investment bankers I've dealt with still like to see the numbers on a spreadsheet," said Stan D. Monsowitz, director of financial services consulting at the marketing development unit of Cap Gemini America Consulting, New York.





METAPHOR MIXER **from Maxus Systems produces a graphic representation of stock market activity.**

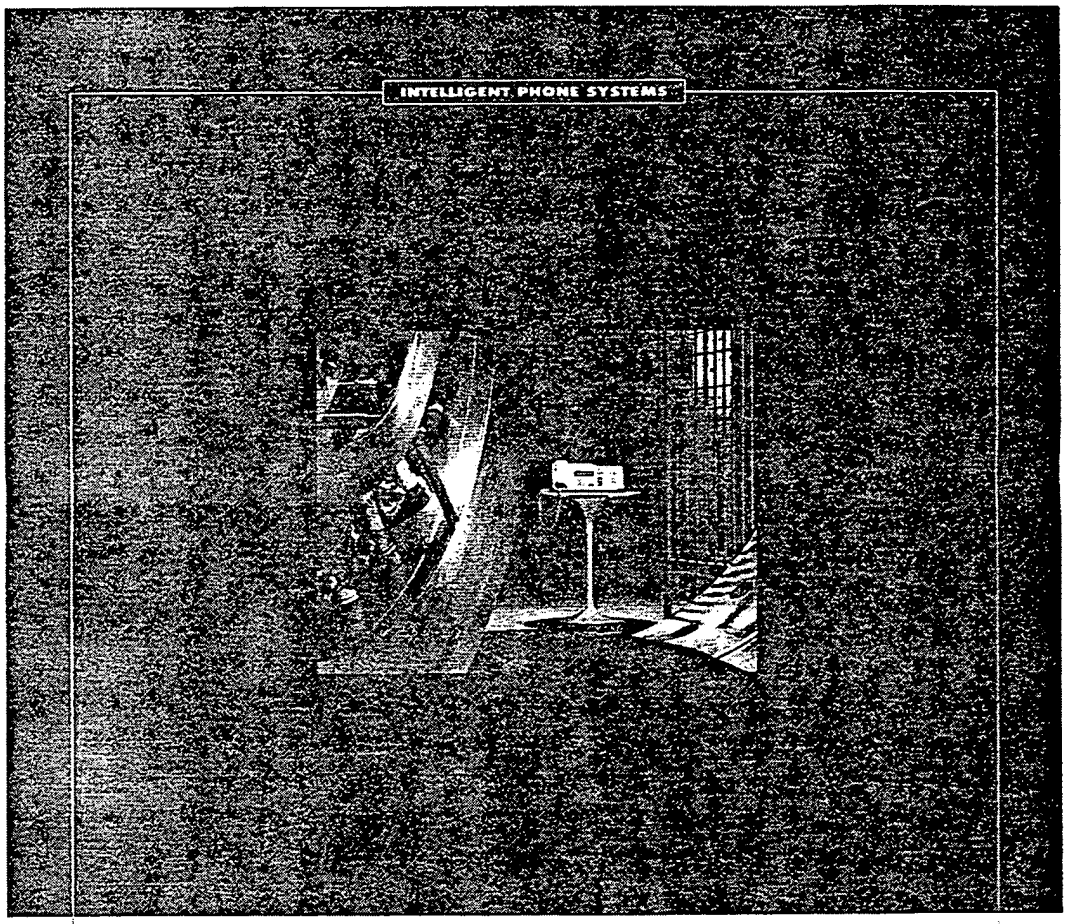
Metaphor Mixer "might make life easier for some traders, but I don't know if it could be a real big seller."

Others, however, say that the rise of global investment opportunities and the booming popularity of derivative products have created an even bigger market for tools like this.

"The technological level required to analyze these markets is making it more of a technology race" than anything else, said Mr. McNees of Towers Perrin. "The person with the fastest capability to focus on the trading opportunity and the know-how to execute it will have the premium."

Mr. Gabriel's boss agrees. "To get an edge in the markets, you have to have some special tools on the trading desk," said Herbert Doenges, manager of ABD's equities and fixed-income trading areas.

From his vantage point, Mr. Gabriel believes ABD's virtual-reality trading system will help the firm's relatively small 140-employee investment bank compete against the Wall Street powerhouses. □



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Virtual Artwork by Jenny Holzer

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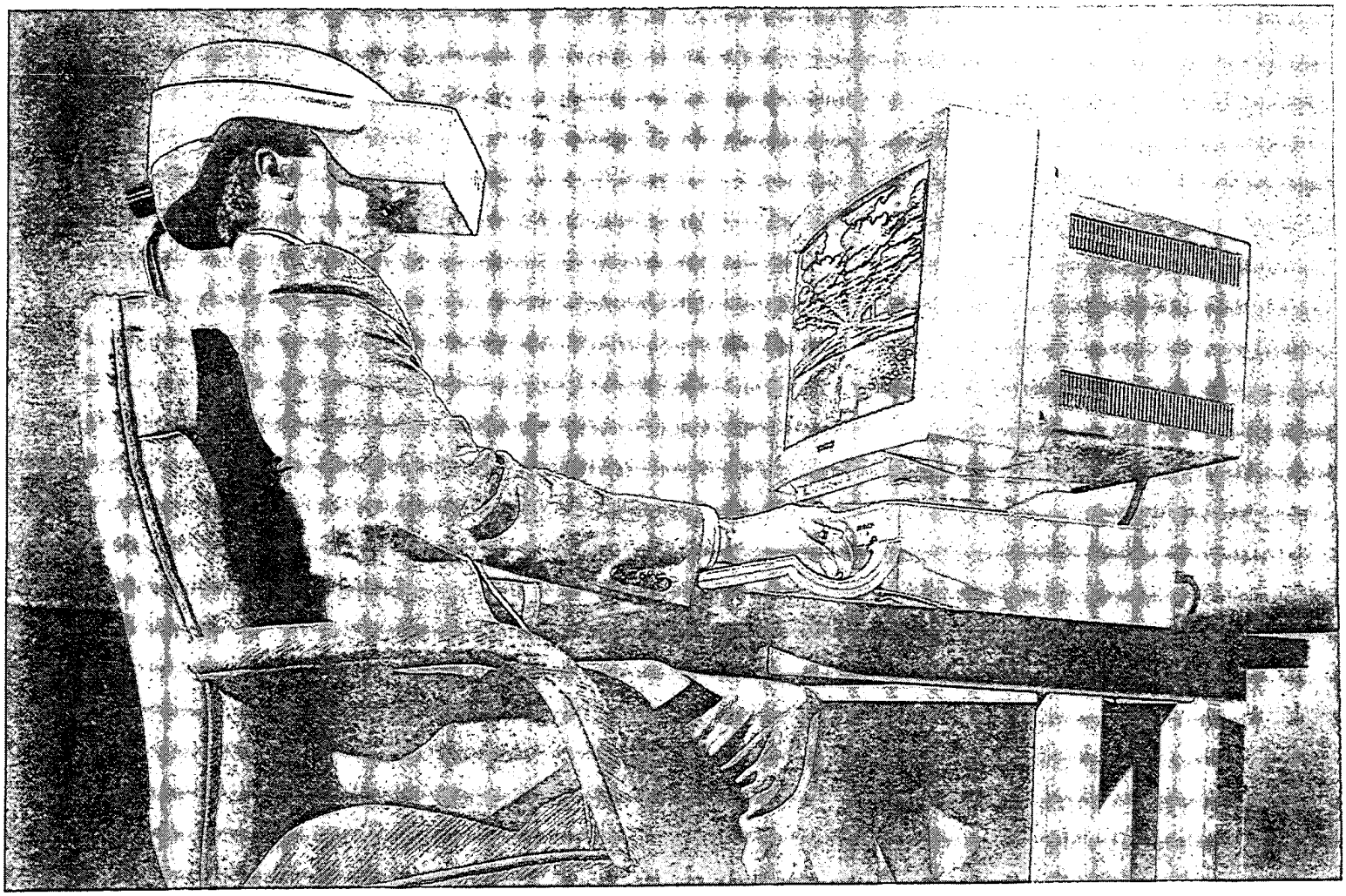


Virtual reality promised a 3D computer-generated world. But all we got were goggles and an arcade game. Now the technology has moved on. JIM McCLELLAN immerses himself in cyber-culture and explores the cutting edge of virtual art

YOU COULD be forgiven for thinking virtual reality belongs in a museum devoted to futures past, to technologies which were going to change everything but never quite did (it could sit next to holograms). Virtual reality promised heaven -- the liberation of the imagination – and hell – the ultimately addictive image. The 3D computer-generated world you could walk into. But all it has delivered so far is a collection of goggle-eyed media stories and a low-res, high-cost arcade game. True, the terminology became useful for advertising executives. Everything from Cyborgasm, an audio CD of 3D sex fantasy, to rave videos of migraine-inducing cheap computer graphics was sold as virtual reality.

'We really do need a new name,' says Kevin Teixeira, co-author of *Virtual Reality: Through the New Looking Glass*. 'The term "virtual reality" is part of the problem these days. It only adds to the confusion and raises expectations.' He has a point. A new name would demonstrate that virtual reality, the technology, has moved on from virtual reality, the hype. We may be ready to write off VR as the cyber-generation's C5, to consign it to the past, but it has a definite future. Paradoxically for Teixeira, in his capacity as head of microchip manufacturer Intel's digital Education and Arts group, a museum was the best place to suggest what it might be.

Hence Virtual Reality: An Emerging Medium, a week-long show funded by Intel, and held at the Guggenheim Museum's offshoot in SoHo, New York, this autumn which featured virtual art from Jenny Holzer, best known for her LED displays of lucid slogans and 'truisms', and virtual music from keyboard wiz Thomas Dolby, who enjoyed a brief period of electro-pop stardom in the early 1980s. Given the amount of VR PR that's been done in the last few years it was hardly surprising that the show was a sell-out. For Teixeira, one point of the event was to challenge a few virtual myths: the visions of screen sex, digital drugs and 21st century rock'n'roll celebrated by Mondo 2000, the magazine devoted to tracking techno sub-cultures, and the current idea that all VR promises is a more intense shoot-'em-up.

Instead, he argues that virtual reality is a new medium of communication. It should be thought of not as a substitute reality, but as a new computer interface. First, he explains, computers were treated as calculators – turbo-powered number crunchers. Then they were treated as super-smart typewriters. Both are fairly limited and limiting images. In the future they will be viewed in more general terms, as machines that help access and control all kinds of information. VR is part of this shift.

cyberspace

Watching people use the exhibits, however, it became clear virtuality is still something of a state of mind. You don't get there just by putting the goggles on. Most people sat stock still and just moved the joysticks. They took a while to realise they could move their heads and look around. You do need time to convince yourself that you're really there, that you're not just staring at two tiny TV screens which happen to be very close to your eyes, more time than the five minutes allotted to visitors to the exhibition. But time in the virtual world costs money, and there's always a queue of people watching the clock, waiting for their go.

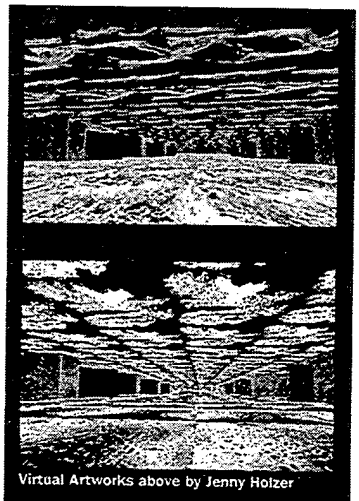
The one exhibit which quickly overcame the problem of immersing the user was the Interactive String Quartet, developed by Thomas Dolby and Eric Gullichsen. Here, you immediately found yourself in the middle of a cartoony string quartet playing Mozart. As you walked around, the music changed as it might if you actually were in the room with the quartet. By approaching the players and wiggling the joystick, the musicians could be made to improvise, add a jazz solo or a dissonant counterpoint.

Dolby says the programme grew out of a desire to come up with a computer entertainment which 'was aimed at your endorphin glands rather than your adrenals'. The important thing for him was to concentrate on something the technology can do at the *moment* (3D audio) and forget about things it can't (realistic 3D visuals). 'The bottom line for me is that people have to have fun. At the moment, the hype is getting in the way, to the point where, if you announce a virtual reality exhibition, you have a line round the block, but nobody comes back a second time.

'One reason I find VR so seductive is that it's a world where there are no real rules or morality. It's a bit like lucid dreaming. It's like when you're a teenage kid and there's that moment you realise you're dreaming, say about this girl you really fancy, and it doesn't matter if you look up her dress, because you're only dreaming. VR's a bit like that. People have talked a lot about virtual sex, but the power it offers is very seductive too.'

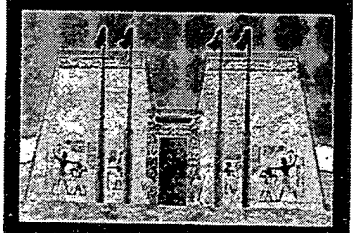
It's doubtful whether Jenny Holzer would greet Dolby's vision of digital wet dreams with much enthusiasm. She was there to bear out Teixeira's belief that VR was a new medium that could say something. Perhaps inevitably, what she wound up saying was something about VR. In collaboration with programmer Ken Pimentel, Holzer contributed a kind of virtual war memorial, a response to the conflict in Bosnia. Inside was a blasted landscape, with occasional villages of brick shacks. Echoing voices recounted the rapes committed during the war as seen from the perspective of perpetrators and victims.

Holzer wanted to cut through the virtual babble and remind people that VR technology was developed by the American military for use in flight simulators and targeting systems. Set against magazine stories which droolingly await the arrival of virtual sex, her reminiscences of rape achieved an extra resonance and helped to question the sense of disengaged power and control VR generates, the God's eye view it gives its user. 'I went to VR because it's like doing an installation, in that you control everything about the space, and it's immersive,' she says. 'The idea with the Bosnia piece was that I wanted people to feel a bit what it would be like, to feel that they couldn't back out of it. It's not only in front of you, it's behind you as well. I didn't want to go for photo-realism, but I wanted it to refer to things that did actually happen in our world. I didn't want it to seem like some sex-in-outer-space fantasy.'

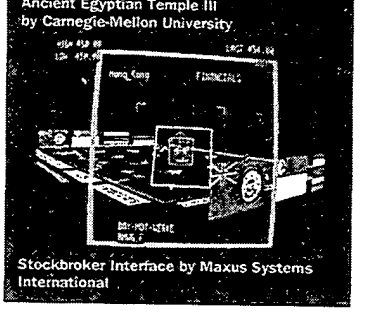


Virtual Artworks above by Jenny Holzer

Interactive String Quartet by Thomas Dolby



Ancient Egyptian Temple III by Carnegie-Mellon University



Stockbroker Interface by Maxus Systems International

One problem for artists like Holzer is that the cost of the new technology makes them dependent on big business. Kevin Teixeira makes no bones about the fact that the exhibition is being staged to remind people that VR is brought to you by Intel's chips and in the hope that the artists involved might generate some new ideas. Does Holzer worry that she's engaged in corporate R&D and PR? 'It's a concern, but I think it'll be hard for Intel to make hay out of rape and murder. And to my astonishment, they did give me a totally free hand. They didn't insist on a happy piece.'

In contrast, the exhibit by Paul Marshall of Maxis Systems International was a brazen example of the 'interface' between art and commerce. Called The Metaphor Mixer, it's a 'virtual stock portfolio'.

'Everybody else is representing real objects in the virtual world,' says Marshall excitedly. 'My idea was to represent abstract information. That's where I think VR is going to pay off for business, as a very high level interactive interface for data. In the average dealing room or office, you have a data feed like Reuters coming in, which is like this huge firehose of information. With current interfaces, it's like you're trying to suck up what you need with a straw.'

Maxis's idea was to develop a programme that used virtual space to bring different sources of information together into manageable forms. Fans of William Gibson's cyberpunk SF novel *Neuromancer* might see The Metaphor Mixer as a rudimentary version of his 'cyberspace', a transnational digital landscape of neon pyramids and skyscrapers built from and representing the data banks of large corporations. Others might see a modern version of the 'memory palaces' constructed by medieval thinkers.

All of the above are taken by some techno-theorists as proof that we want information to be space. Marshall agrees. For him, the Gutenberg Galaxy was a transitional detour. Our leftover monkey brains were never really happy with text. Fiddling around with 3D visual simulation will be much more comfortable. Once you get used to the programmes, he says, you can handle '10 different dimensions' of information at once. And that means you can buy and sell much quicker, that micro-second quicker.

The Guggenheim show wouldn't have been complete without a chance to chew the ritual fat. Even for enthusiasts, VR isn't something you do so much as talk about. Since its media arrival four years ago, there have been a whole series of events devoted to pondering its implications, labelled the 'virtual rubber chicken circuit' by cynics. 'There's always someone who gets up and asks when they'll be able to have sex on it,' jokes Teixeira. 'There's always someone who gets up to remind you that PC doesn't just stand for personal computer, that there's sexism in cyberspace too.'

In the end the Guggenheim's Virtual Symposium turned out to be remarkably constructive. It followed Teixeira's general brief that it was time to get real about virtual reality, to the extent that it drew up battlelines between the virtual good guys (hackers and cyberpunks), who were interested in using VR for communication, and the virtual bad guys (the military) who were interested in simulation.

According to downtown intellectual Manuel De Landa (the author of *War in the Age of Intelligent Machines*, a mix of military history and chaos theory), the American military (which is trying to establish a technological standard for VR) is pushing for realism (the goal being ever more accurate virtual target practice). Against that, he set the efforts of people developing computer networks and bulletin boards. It's true that, for the digital in-crowd and cyber-culture that first celebrated VR, the tide has turned. Nowadays cyberspace is the place. People talk about 'virtual communities', about hanging out and hooking up on the Internet, the international information network. Virtual reality is something of a dirty word.

All the more reason to come up with a new name. So by the end of the week, was Teixeira any closer? 'It'll take time. They had several names for films in the early days, but now we just call them movies. Maybe we'll call virtual worlds "immersives". What do you think?'

I think we're all going to be living with virtual reality for some time to come ■

Technobabble

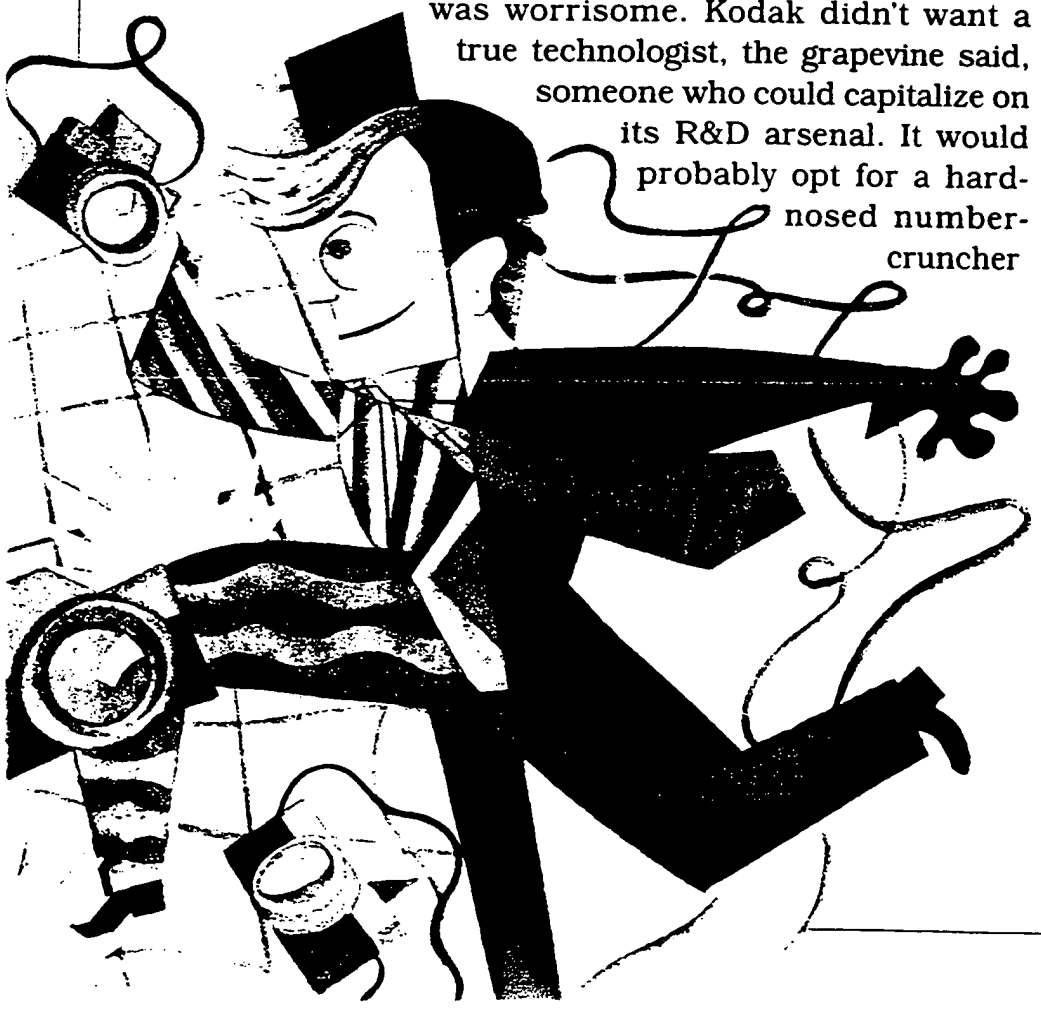
Virtual Reality: a combination of hardware and software for creating or accessing a computer-created environment of sound and vision.
Cyberspace: a totally encompassing world existing entirely within a computer which may be accessed via a modem or goggles.
Goggles (or VR helmet): a sort of computerised version of stereoscopic glasses, with two screens showing slightly different video or computer-generated images.
Joystick: a cursor control device for computer games and some professional applications such as computer-aided design.
Data glove: a sophisticated computer device for controlling VR programs. It's worn like a glove and contains a number of sensors.
Interactive interface: this might be a video or a CD which offers the viewer a choice of endings, or a game with options.
Low res: a low resolution screen.
Chaos theory: the notion that even the smallest action has some bearing on much larger events. One example is the movement of a butterfly's wings ending in a hurricane.
The Gutenberg Galaxy: book by 1960s media guru Marshall McLuhan, named after a 15th century German credited with being the first European to use movable type cast in moulds. McLuhan's premise was that the electronic media replacing the printed word would profoundly affect human perception.

INSIGHT

NEWS ANALYSIS

Getting to the Bigger Picture

When George Fisher was recruited in October to head Eastman Kodak, a move that surprised even his colleagues at Motorola, the announcement was a shot in the arm for the ailing photography giant. Kodak had brought aboard a highly-sought talent earlier in the year, chief financial officer and corporate strategist Chris Steffian, only to lose him a few months later, after Steffian concluded the company's autocratic management was too resistant to change. Even when Kodak's directors threw down the gauntlet and decided to replace chief executive Kay Whitmore, its slow-footed legacy was worrisome. Kodak didn't want a true technologist, the grapevine said, someone who could capitalize on its R&D arsenal. It would probably opt for a hard-nosed number-cruncher or (scarier still) a marketing type. The company that had blazed the trail for shutterbugs the world over was now making its living pushing Mop & Glo and Bayer aspirin along with its film products.



Russell O. Jones

So Fisher's appointment was seen as a coup. He's earned his technological stripes, all right: a Ph.D. in applied math, training in AT&T's renowned Bell Labs, constant innovation and splendid results at Motorola, where he had been chairman and chief executive since 1990.

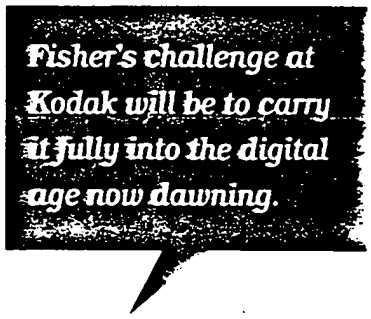
In fact, within 24 hours of the announcement of Fisher's move to Rochester, Kodak's stock shot up 10%, to $58 a share. That increased the company's market value by some $190 million, more than enough to cover the hefty compensation package dangled before him.

But make no mistake about how Fisher will operate. Great technology does not equal a great company, if the wizardry never gets out of the lab and into enough people's living rooms. For all of Motorola's scientific smarts, it still needed the push by Fisher and other executives to identify and place big bets on emerging demands for cellular phones and specialized chips—and then to market the hell out of them. "It's a humbling experience for technologists to discover you can make a lot more money on a pager just by changing colors," Fisher said of his Motorola success.

Humbling, but ultimately profitable. And more secure, since fashions and styles change faster than even PC configurations; by keeping pace, companies learn how to instill flexibility and nimbleness in their cultures. And by paying attention to subjects as seemingly arbitrary as color, brand managers will have a better feel for what consumers really want from their products, and they will gain clues about where the next stage of development might lead. That's a lesson far too many technology companies, small

to large, have yet to learn. Technology is still the engine that drives a company, but the consumers are the ones who are paying for tickets to ride it.

To help boost Kodak's prospects, Fisher intends to speed up the product development cycle and cast its net wider in the imaging field. A stronger presence in Asia, where Kodak has lagged, and a shoring-up of finances will help, too. So will a boost to morale of the company's beleaguered workforce (though more layoffs are certain to come). In the end, Fisher's biggest challenge at Kodak will be to take what is seen as a mundane, almost quaint process—still photography—and carry it fully into the digital age now dawning.



Here is where Kodak provides a second lesson to all Bill Gates or George Fisher wannabes. Content still defines the technology experience, whether supplied by the consumer (the photograph as the self-selected version of reality: the pager as the vehicle for the self-created message) or provided by an artist (the version of reality offered by a software game developer, film director, soap opera scriptwriter, and so on). If the content is presented in an awkward or illogical or confusing manner, no matter how dazzling the product, it won't sell. Remember the Kodak disc camera? Or 8-track tapes and Beta VCRs? Or *Ishtar* or *Legs Diamond*, for that matter? Kodak knows more about capturing images than any other company, but it has to do it in ways that enrich people's lives, rather than just use a lot of batteries.

Consider virtual reality, which is the next step beyond two-dimensional reality. Why hasn't VR caught on? For one, the technology isn't mature yet. But even when it is readily available to consumers, by mid-1994 or early 1995, according to its proponents, the easy experience of the content has to be the lure. "Virtual" representations of reality have been around for centuries, from Alberti's treatise on linear perspective in Renaissance Italy to the Victorian-era stereoscope to panoramic paintings and photos. It's the much more mundane forms of reality, however, such as books, newspapers and television, that have grown into dominant media, because they are tremendously accessible, affordable and reproducible way of presenting content.

A recent exhibition at the Guggenheim Museum's Soho branch (that's downtown New York, not small office/home office) demonstrated how artists are using VR. Much of it was still crude in execution and lacking in original ideas for the medium. But the potential to make that transforming leap, via content, is there. One installation, called "Metaphor Mixer," was a demo of an actual VR product being peddled to Wall Street firms. As designed by Maxus Systems and Paul Marshall, the program displays a grid of five countries and selected commodities, such as stocks, oil, precious metals and currencies. The user can zoom over the grid, select a specific cell, and get real-time information on trading volumes and prices.

Right now, notes Marshall, his Wall Street customers are only using it as a two-dimensional tool, another picture to throw on their trading screens to handicap the market. But in its full-blown form, the program can employ software agents to track individual preferences and investment targets across a range of variables (10 seems to be the upper limit for now). With the proper VR apparatus, trends will emerge and connections will leap out that would not be so apparent on a PC monitor. "People think of VR as games, or guys with dreadlocks," says Marshall. "No one thinks of it as information design. But if you take some time to explain it, it's a visual language, a grammar." In other words, a new, compelling way to represent reality and relay content to the user.

For VR to emerge, it will need to exploit fully the potential of ideas like the Metaphor Mixer. And it will need plenty of backing from patient companies willing to risk lots of money. The sponsor for the Guggenheim show was an unconventional arts patron, Intel. "VR has incredible needs for horsepower to render 3-D environments," says Marshall. "That's why Intel was behind this. They realize no one is going to buy a Pentium to watch a spreadsheet update one second faster."

Spoken like a true marketer.◆

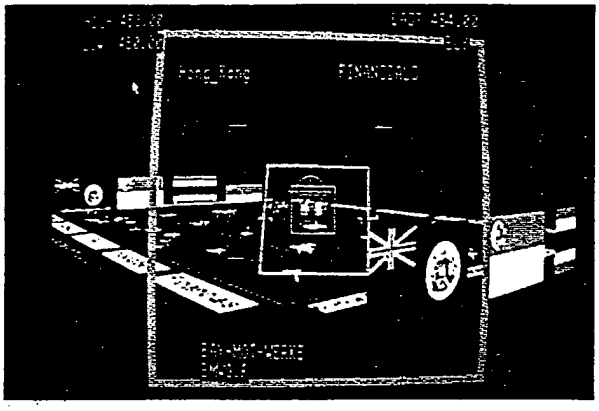
—Eric Garland

SHORT TAKES

Where they don't drink the water or pay for the software. 85% of business software in use in Mexico was obtained illegally, says Carol Bartz, CEO of Autodesk, who's championing legislation she hopes will increase legitimate sales. Anyone looking for more statistics on Mexico, Japan, or China can call Business Software Alliance at (202) 872-5500. . . **It was nice while it lasted.** Staples, the office-supply retailer, dumps Dell for Compaq, giving the Houston manufacturer the premier spot on its shelves . . . **Looking for a new perspective.** Real World Intelligence has launched an electronic service it claims can synthesize and distill all the information needed to run a technology business through a custom-designed search-and-retrieval service. Call (206) 378-3908. . . **Trade show madness.** For helpful hints on how to evaluate trade show leads and advice on how to use trade shows to tap into the Pacific Rim market, give a call to HLB Communications at (312) 649-0371, and ask for Bottom Line, a newsletter targeted at event marketers. . . **Direct marketing "down under."** LISTman is a new direct marketing software package that claims to help users manage direct-mail prospects and leads more effectively. The Australian company, Direct Marketing Software, is located in Brisbane, Queensland at 011-61-7878-3003. . . **Everything but the kitchen sink.** Database America is offering a variety of lists with data from Dialog, Standard & Poor's, Mead Data Central and BusinessWeek. The number to call is (201) 476-2300. . . **Over there, over there.** The European outsourcing market is set to more than double by 1997, says Ovum Ltd. of London. For information pertaining to breaking into this market or for establishing a presence by leasing and supporting equipment, call the company at 011-44-71-255-2670. . . **Two kinds of brew.** The average account executive drinks 1,273 cups of coffee per year, while the average creative team consumes 2,648 glasses beer each year, according to Anderson & Lembke, and that's why the agency is moving its San Francisco offices to a new location: 2 Harrison Street, original home of the Hill Brothers Coffee Company and Gordon Biersch Microbrewery.◆

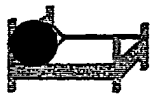
Play Money

We've always believed that virtual reality was too good to be wasted on ordinary reality. Now a company called Maxus Systems is using it to represent the alternative reality of Wall Street. Their system, called Metaphor Mixer, represents investment options as a kind of Vegas game table with floating color chips and "profit missiles." Now in use by a number of securities firms, including ABD Securities (a US arm of the German Dresdner Bank), the Metaphor Mixer links professional expertise to visual sensibilities.



Metaphor Mixer, says Paul Marshall of Maxus, is a virtual reality system that "allows the client to 'fly' over the entire financial world," represented as a huge grid with each square corresponding to a country and industry group. Real-time data reports are fed into the system; stocks are represented by color-coded shapes. Spinning and blinking shapes symbolize various performance patterns – spinners, for example, represent optimal price to earnings ratios – and "profit missiles" home in on attractive securities. There's even a kind of agent – a "wingman" that can be dispatched to look for particular mathematical market features. The system, which uses the Spaceball 3-D input device, is based on Sense 8 Corporation's World Toolkit software for creating 3-D virtual spaces. So far, the system only guides decision making, but one can easily imagine the day when trades themselves are placed by clicking on a chip. Metaphor Mixer suggests a model for the virtual trading floor of the future.

We'd love to see a home version – the VR equivalent of Quicken – in which you can plunge down the abyss of your MasterCard balance, ascend the compounding interest of Mt. Optima, or struggle across the vast desert of a 30-year fixed mortgage, while the glimmering mirage of a hot stock tip dances in front of your eyes. Maxus Systems: +1 (212) 481 3688. – *Phil Patton*



TIRED	WIRED
Post-Cold War Recession	The Wired Expansion
Dogma	Karma
The Pope	The Dalai Lama
Bill	Boris
Esquire	*Warp*
Manhattan	Ft. Worth
Time	Warner
MTV	mtv.com
Location Based Entertainment	VRcades
Orlando	Las Vegas
Cable TV	Bell Atlantic
Schwarzenegger	Stallone
Armies	Warlords
vt100	SLIP
FCC	Unlicensed bandwidth
Bell bottoms	Chinos
Smashing Pumpkins	Dead Can Dance

game than the less-than-perfect graphical world of *Speed Racer?* Speed's Mach 5 has been updated with a video screen and various other cool gadgets, but all the supporting cast will appear in the new game, set for release for both Nintendo and Sega early next year. At least the animators repurposing Speed for the gaming world won't have to worry about synchronizing his voice to his lips. ☰ More Trials: When you first heard about the Time-Warner/SGI/General Instruments interactive television trials in Orlando, Florida, you probably wondered why your zip code wasn't the first pit stop on the information buyway. Well, if you live in Omaha, Nebraska, you're in luck: US West, 3DO, and a yet-to-be-named software company, supplying the language, interface and OS, are teaming up to bring more than 100,000 Omaha customers their personal vision of interactive TV by the end of next year. Still feeling left out? Keep lobbying, there should be enough alliances formed

Skinner TV

How do you spell interactive television? John Reardon, former president of MTV, spells it Z-I-N-G. Reardon's latest cable venture, Zing Systems LP, will soon offer "The Zing Device," a remote control-like unit that will allow viewers to become "actively involved" with their favorite TV shows. Hidden text messages, seen only on the Zing Device's display screen, will prompt viewers to play along with game shows and to order products.

Using a Zing Developer's Tool Kit, TV program producers and advertisers will be able to encode the hidden text messages into their broadcasts. Another unit (the Zing Dialer), connected to the user's phone, will send responses back to Zing's cen-

TERRAIN OF EVENTS

The first virtual reality trading systems, allowing data to be explored like the terrain of the real world, are available and helping users make money. Clive Davidson enters the tenth dimension

Much of the information on which derivative traders and analysts base their decisions is multi-dimensional and in real time. The informational dimensions of a derivative instrument can include its market price, premium, implied volatility, delta and expiry date. Some of these dimensions are constantly being updated via real-time data feeds.

These characteristics also apply to the computer-generated worlds of virtual reality. Virtual worlds are created with three-dimensional computer graphics but the objects they call, for instance, change over time, grow or shrink in size, change colour or move in different ways. And some or all of these attributes of virtual objects can be manipulated in real time. Indeed, part of the purpose of the technology is to model active environments with which the user can interact.

The application of virtual reality to financial market information is a logical step that has been speculated about for some time. Now it is actually happening and pioneering traders report that virtual reality is helping them make money.

The first widely available virtual reality system for the financial markets is the Metaphor Mixer from Maxus Systems [illegible] be updated in real time. The metaphor it uses is a terrain with animated objects. The first two dimensions are the X and Y axes of the terrain. A grid of lines can divide the terrain into rectangles with, say, countries along the X axis and industry sectors along the Y axis.

Within each rectangle a number of poker chip-like objects represent stocks or other financial instruments. Their shape can [illegible] indicate whether price is up (red), down (blue) or the same as the day before (grey). The height of the objects above or below the surface of the terrain can indicate how far the price has moved relative to the rest of the market that day.

Each object can have an arrow vector attached to its top, with six possible positions, from pointing directly up to directly down. The arrow can present the results of an analytic such as a stochastic study or a relative index. In addition, each object can be made to blink or spin, indicating, say, positive fundamentals or attractive trading opportunities.

A feature of virtual worlds is that they are navigable – they can be explored like a real-world [illegible] does not require a head-mounted display – but is presented on a conventional computer screen. The user navigates by changing the viewpoint of the virtual world displayed on the screen using a mouse. From a bird's eye view of the virtual market the user might spot an object unusually high above the terrain surface, or another blinking or spinning, and zoom in on these for closer inspection.

[illegible] world. This polygonal object can be programmed to perform a function, guiding the user to the 10 best opportunities in the market terrain. The idea is that the agent acts as an aid to decision-making. One user of the system has the agent attached to a neural network which performs an analysis of the market. The agent then draws the user's attention to the results The Metaphor Mixer gets its information from a real-time risk analysis and portfolio management system called Capri. The system, which runs under Microsoft Windows on a PC with a 486 processor, takes data from real-time feeds

ANIMATED ANALYTICS

"Financial animation" is what Toronto start-up company Visible Decisions prefers to call its visualisation software. Using advanced three-dimensional graphics with the added dimension of time it has developed products for interactive analysis of tic-by-tic market data and for risk management.

The company disassociates itself from the term "virtual reality". Founder Bill Wright believes it will be 10 years before virtual reality systems lose their bulky headgear and gain sufficient image resolution and performance to make them viable for financial applications.

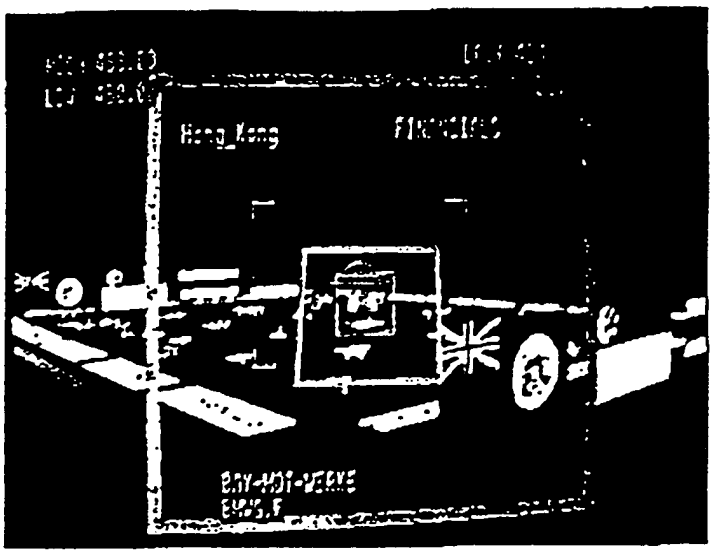
Wright and co-founder Paul Philp are 3-D computer graphics experts who saw the potential for the technology in financial data handling while working for Alias [illegible] computer graphics software used to design cars and create special effects (including some of those used in the film *Jurassic Park*). Todd Finch, the third partner in the company, was with Silicon Graphics, the leading graphics workstation supplier. They sought financial expertise from RBC Dominion Securities in Toronto, whose head of derivatives, Doug Steiner, collaborated on development work and is now chairman of Visible Decisions. The company also attracted $5 million of investment capital.

"To make 3-D graphics work you've got to make it move," says Wright. "So, we're doing everything in 4-D [where the fourth dimension is time]. When you make it move then you can get 3-D graphics to be rigorous, to be comparative, to be analytical and to support decision-making."

The focus in developing the software has been to make the power of advanced real-time [illegible] graphics [illegible] analysts to understand and use. A feature of the software is what Wright calls "brushing" – areas of interest in the landscape of market data can be "brushed" to reveal layers of underlying numerical or text data.

RBC Dominion is one of five beta sites for the new software, which will be launched in June. Two products will initially be available. Market Discovery is a visualisation tool which can analyse and display up to 500 instruments in a computer graphics "landscape". The instruments appear as objects whose colour, shape, size, position and movement convey real-time attributes such as price and volatility. Inventory Viewer, meanwhile, uses graphics and animation to highlight risks and exposure for fixed-income traders.

The software has been built using Silicon Graphics GL graphics libraries and runs on Silicon Graphics Indy workstations. The [illegible] workstations. Visible Decisions has a patent pending on its techniques. Prices have not yet been announced.■



Virtual market terrain: flags along one axis indicate countries, while the other axis shows industry sectors. Financial instruments appear as objects on the grid

Connecticut, where it trades primarily in foreign exchange, energy, metals and derivatives. Market Watch is compatible with Unix Fist and has been developed to incorporate the reliability and resilience usually associated with Unix software, according to Kapiti Market. Watch favoured over AIG's existing Reuters terminals because of its better performance and lower cost, says AIG vice-president Tom Borgenson.

PRICES ON THE SCREEN

Pricing screens running under Microsoft Windows are now available with Version 4 of the Brady pricing and risk management system.

Screens include currency options, caps and floors, swaptions, bond options; options on futures and IRGs, with swaps screens due by mid-1994. The screens use the DDE (dynamic data exchange) protocols to access data feeds such as Knight-Ridder's MoneyCentre for Windows, ACT Financial Systems' Citydesk and BT's OTSview.

The screens connect directly with Brady's risk management and back-office systems. The software was developed using object-oriented techniques and is part of Brady's conversion of its systems to the Windows environment.

LOTUS REALTIME GETS NEW OWNER

Lotus Realtime, the real-time graphical spreadsheet, has been bought by one of its value-added resellers, Market Arts Software of New York.

The aquisition ends speculation about Realtime's future since Lotus Development Corporation unexpectedly halted development work on the product last July. Realtime is widely used in banks, brokerage houses and money management firms to analyse data from live feeds and to incorporate the data into third-party systems. Market Arts will provide consultancy and maintenance for Realtime and integrate it into its software and customised application development.

into a database and applies analytics to the information. The Metaphor Mixer presents a visual summation of the analytics that Capri is computing. All the numerical results of this computing, which are used to define the virtual objects, are available at a click of the mouse button.

Capri and the Metaphor Mixer were developed by Paul Marshall, executive director of Maxus, who came to appreciate the value of using computer graphics to visualise real-time market analytics while at Teachers Insurance Annuity Association–College Retirement Equities Fund (TIAA–CREF), a multi-billion-dollar US pension fund, where he lent stock to short sellers.

"Metaphor Mixer turns a firehouse of information into a real-time graphical display that is information-rich and understandable," says Marshall. The system is generating considerable interest in the financial world. What is more, its early adopters say it has definitely helped them make money.

In theory the Metaphor Mixer could visualise the output of any real-time analytics "engine" besides Capri, although so far this has not happened. The Metaphor Mixer was developed in a virtual reality package called WorldToolKit from Sense8 Corporation of Sausalito, California. It requires an i860 processor-based graphics accelerator add-in board for the PC. Any input device can be used with the system, including a conventional mouse, a 3-D mouse, a joystick or a "dataglove".

One of the first successful applications has been at ABD Securities, a subsidiary of Dresdner Bank in New York. There George Gabriel, then vice-president of foreign institutional trading, and Bill Scovin, then a researcher in international equities, used Metaphor Mixer to monitor underlying equities and warrants in the German market.

The virtual reality system gave them "an instantaneous presentation of what was theoretically overpriced and theoretically underpriced", says Scovin. This "all-encompassing glance" enabled quick assessments of good trading opportunities, hedges and other strategies – something they could not get from any other product, he says. Scovin believes the Capri/Metaphor Mixer system has particular value in the complex strategies of derivatives trading where, for instance, short and long positions must be maintained in delicate balance.

Scovin has recently moved to Nomura Research, while Gabriel has gone to Merrill Lynch – both potential customers for Metaphor Mixer. TIAA-CREF uses the system, while in the UK, Syntegra, the systems integration subsidiary of British Telecom, is in discussions with Maxus on marketing the system and integrating it with BT's OTS (Open Trading System) products. According to Jitu Parmar of Syntegra, the integration will involve Capri, or an organisation's own analytics engine, taking in data from OTS and feeding it through to Metaphor Mixer. It is not a simple task.

"It [Metaphor Mixer/Capri] is a complex product and every customer will use it in a different way," says Parmar. The system must be customised to the user's application and carefully integrated with their systems. Nevertheless, interest shown by BT customers so far has been "tremendous", says Parmar.

Meanwhile, fully immersive virtual reality trading systems still seem some way off. Scovin suggests that dealing rooms are not yet ready for traders with head-mounted displays lost in financial cyberspace. The technology is not there yet either.

"The systems would have to get to the point where they were so fast and responsive that you could actually conduct trades in them by simply pointing at objects," says Scovin. But he believes that the technology is undoubtedly heading that way. The Metaphor Mixer system starts at around $10,000, or $1,000 a month, depending on the system.■

VIRTUAL REALITY

HOW A COMPUTER-GENERATED WORLD COULD CHANGE THE REAL WORLD

Psychologists call it "suspending disbelief." Computer jocks call it entering "virtual reality." Whatever the jargon, it doesn't begin to describe what happens in Arlington, Va., at the Institute for Defense Analyses.

You sit in a wood-paneled room as Colonel Jack Thorpe, special assistant for simulation at the Pentagon's Defense Advanced Research Projects Agency, douses the lights, flips on a computer—and sends three five-foot screens in front of you thundering into action. Instantly, you're transported inside a tank rolling across the Iraqi desert. You are performing the same maneuvers as a unit of the 2nd Armored Cavalry during "73 Easting," an actual battle in the Persian Gulf war. The graphics on the screens are only video-game quality. Yet, the illusion works: You duck as shells scream toward you and explode in ear-splitting fury.

It isn't unusual for soldiers participating in this exercise to curse or sweat as the computer-simulated fight unfolds. Something else happens as well: Their scores for battlefield acumen improve dramatically after they practice with these video tank crews. In an era of shrinking defense budgets, such training offers invaluable experience without the cost, damage, and logistical hassle of war games. "We will expect a smaller military to be masters of a wider ensemble of skills," says Thorpe. "This is an idea whose time is right."

NEW SENSATIONS. The cyberspace tank battle is primitive compared with visions of "virtual reality" trumpeted in books, movies, and the TV show *Star Trek: The Next Generation*. There, intergalactic travelers use computers to conjure up Sherlock Holmes's London or a sexy date. But as DARPA's system proves, computer-generated worlds don't have to be super-realistic to evoke real life. That fact is turning virtual reality into a red-hot technology.

There's plenty of confusion over what VR is. But to most developers, the core of every system is a data base that contains data from a brain scan, specifications for a car dashboard, the description of a fictional landscape—in short, data that can represent almost anything. A powerful computer with sophisticated graphics then renders a "world," often in 3-D, that recreates precisely what the data describe. VR displays vary widely, from images on a computer monitor to theater-style displays such as 73 Easting to projections on stereoscopic lenses mounted inside helmets that VR participants wear.

Whatever the approach, two characteristics distinguish VR worlds from other computer graphics: Increasingly, they convey multiple sensory information—sound or touch—to make environments more realistic. And they are interactive. In some systems, a viewer wearing a sensor-laden glove manipulates objects in the computer as one would naturally. In others, images on the screen or a viewer's perspective are manipulated with a mouse or joystick.

At IBM's Watson Labs in Hawthorne, N.Y., for instance, an engineer seated in front of a projection screen, looking at a sleek, beige dashboard becomes a test driver for a 1997 Chrysler. Wearing 3-D glasses and a glove with sensors, he turns the steering wheel and reaches for buttons as though in a real car. Chrysler Corp. is developing the system with IBM in hopes that the exercise could cut months off the three-year to five-year car-design process by letting engineers spot inconveniently positioned knobs and other problems before they surface in expensive prototypes.

'PAST THE HYPE.' Intrigued by this kind of potential, dozens of government, university, and industrial labs, from NASA and the Defense Dept. to the University of Washington (UW), are embracing virtual reality. In the next four years, the military hopes to spend more than $500 million on simulations. This fall, the Army will likely award an additional $350 million, eight-year contract to create an advanced network for battlefield simulations. Industry giants—including Boeing, AT&T, Sharp, and Fujitsu—are investing millions, too. At UW's Human Interface Technology Laboratory, some 19 companies have created the Virtual Worlds Consortium to apply VR to business. "Forget the games and electronic sex," says Bryan Lewis, a researcher at IBM. "We are past the hype and pursuing real applications."

This could be a boon to computer giants such as IBM, DEC, Apple, Sun, and graphics workstation maker Silicon Graphics. VR represents a potentially big market—and a flashy selling point—for their muscle machines. Startups including Exos, Virtual Vision, and Fake Space Labs are building gear to enhance VR

CYBERSPACE SIMULATIONS MAY ENHANCE JOB PERFORMANCE AND TRAINING, IMPROVE PRODUCT DESIGN, ASSIST SURGEONS, AND CREATE INTERACTIVE FORMS OF ENTERTAINMENT. BUT IT WILL BE YEARS, IF EVER, BEFORE ALL THAT IS A REALITY

worlds—viewing devices, acoustical chips, and sensors. Autodesk, Sense8, VPL Research, and others see their fortunes in systems that business can use.

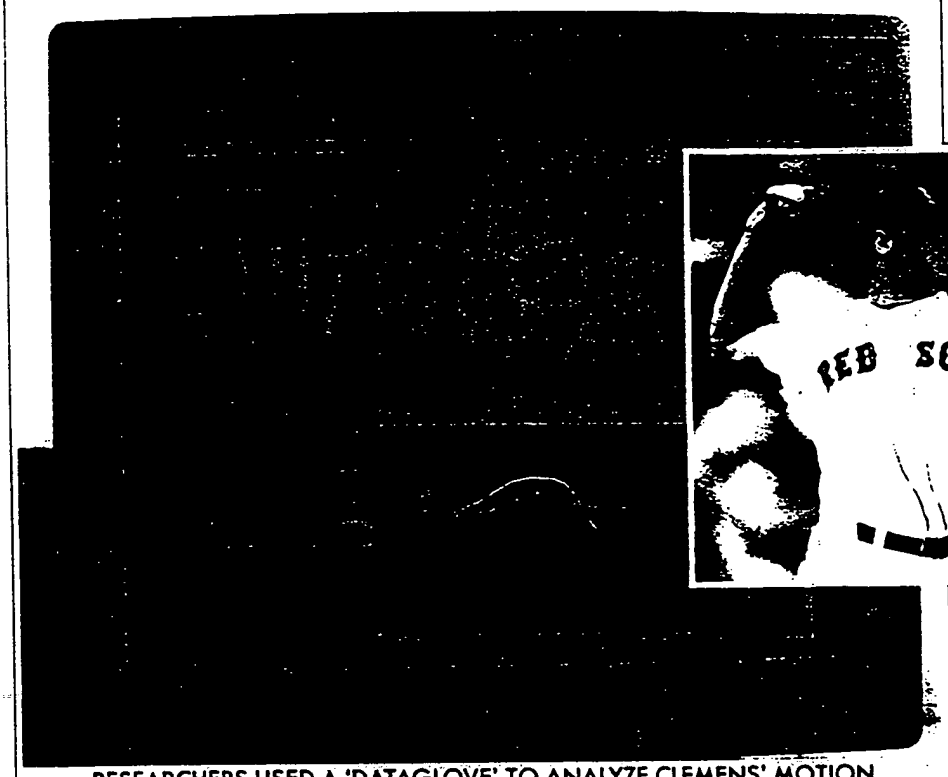
For good reason. Cyberspace worlds that exist only in the electronic ether can be a powerful tool in the hands of architects, engineers, and scientists. They can also be used to boost productivity, improve product design, and provide more cost-effective training. In medicine, VR tools are being used to create 3-D X-rays to help surgeons plan procedures or assist in surgery miles away. Psychologists want to use the technology to treat patients and to study human behavior. Artists and entertainment moguls are pioneering new attractions—interactive theater, interactive fiction, and even virtual sculpture, cyberspace works that defy the laws of physics.

Whether VR systems will ever match the sophistication they display in fiction is far from certain. The field faces huge technical hurdles: Success will depend on improvements in hardware and software, plus new insights into the human brain and behavior. And as systems become more "real," they will pose thorny ethical questions: Could VR influence people in pernicious ways that conventional media cannot?

Still, VR's social and economic potential seems clear. Democratic Vice-Presidential hopeful Al Gore considers VR so crucial to "the way we design new products, teach our children, and spend free time" that last year he chaired hearings on its value to American competitiveness. The conclusion: The U.S. is underinvesting in the technology.

To VR advocates, that's a mistake. Virtual reality represents "the manifest destiny for computers," asserts Eric Gullichsen, founder of VR software producer Sense8. By creating worlds of color, shapes, sounds, and feel, these systems should amplify the powers of the mind to see previously hidden relationships in complex sets of data and to absorb, manipulate, and interpret information more quickly and completely. The distinction between immersion in a VR world and analyzing the same information using blueprints, numbers, or text "is the difference between looking at an aquarium and putting on your scuba gear and diving in," says Thomas Furness, director of UW's Human Interface Technology Laboratory.

BUMP AND GRAB. Just ask engineers at Northrop Corp., who are using a VR system from Simgraphics Engineering Corp. to help redesign the Air Force's F-18 fighter jet. They model air-intake ducts on computers to make sure they fit through bulkheads, rather than building expensive hard models. An operator wearing wraparound goggles moves parts around with a type of mouse, making sure they fit together in virtual space. The software even simulates resistance, so engineers know when parts "bump" against each other. Project Engineer Robert E. Joy loves the flexibility: "It's like reaching into the workstation and grabbing the part," he says.



RESEARCHERS USED A 'DATAGLOVE' TO ANALYZE CLEMENS' MOTION

ANATOMY OF A FASTBALL

Hurling a 100-mile-per-hour fastball down the middle is a special skill worth analyzing. But a big-league pitcher's arm, wrist, and finger movements change so rapidly that they're almost impossible to dissect. This thwarts efforts to learn from good pitchers—or figure out what's wrong when they have injuries or slumps.

Insights into these puzzles of movement could come from a new data-collection tool that's integral to virtual reality. Greenleaf Medical Systems, a four-year-old startup in Palo Alto, Calif., has licensed the "dataglove" from VPL Research Inc. for medical uses. A black Lycra glove with fiber-optic cables attached relays movement signals to a computer, which quantifies hand motion. In a recent experiment, Greenleaf put datagloves on the hands of four Boston Red Sox pitchers, including team ace Roger Clemens.

Attached to an Apple Macintosh computer, the glove recorded subtle relationships between speed, position, flex, and other variables as the four men threw a variety of pitches. For every three-second pitch, the system compiled 16,000 data points. Red Sox associate team physician William J. Morgan is building graphic images to see what he can learn. By repeating the experiment, he hopes to identify movement changes that make a pitcher less effective—and correct them.

Company founder Walter J. Greenleaf sees broader potential in the experiment: He envisions a huge market in analyzing repetitive-stress injuries, an increasingly common malady of office workers, and in diagnosing other orthopedic and neurological ills. He also hopes to make patients who can't speak able to communicate through gestures the computer interprets.

PHOTOGRAPHS BY ROBERT HOLMGREN; INSET BY FOCUS ON SPORTS

VR represents the second major effort in two decades to bring about a dramatic evolution in computers. The aim of the first, artificial intelligence, originally was to build systems that could mimic human reasoning, a goal that has yet to be reached. Virtual reality is the antithesis of what AI tried to do. It aims "to extend the power of the person" says Robert Jacobson, president of WorlDesign, a Seattle VR software startup.

That's what a visualization tool designed by Maxus Systems International does for managers at TIAA-CREF, a New York pension fund with $105 billion in assets. Tracking the performance of a group of stocks against the larger market is a challenge for analysts, who must follow hundreds of ever-changing numbers. Using software from SenseS, the Maxus system converts the numbers to a 3-D schematic of colored squares that move and symbolize individual stocks within grids representing market and industry sectors. It runs on a personal computer and draws on real-time feeds from financial wires.

A specialist in bank stocks may glance at the computer and notice that a box showing banks in the Pacific Rim is active. The squares are red, a signal that the stocks are falling. The analyst uses a mouse to "fly" into the lowest tier of stocks, which have plunged the fastest, and click on the security that has dropped most. Up pops text on that bank. The process takes seconds, so portfolio managers can "identify trends, recognize exceptions, and make decisions more quickly," says SenseS President Tom Coull. "That can translate into a tremendous amount of money."

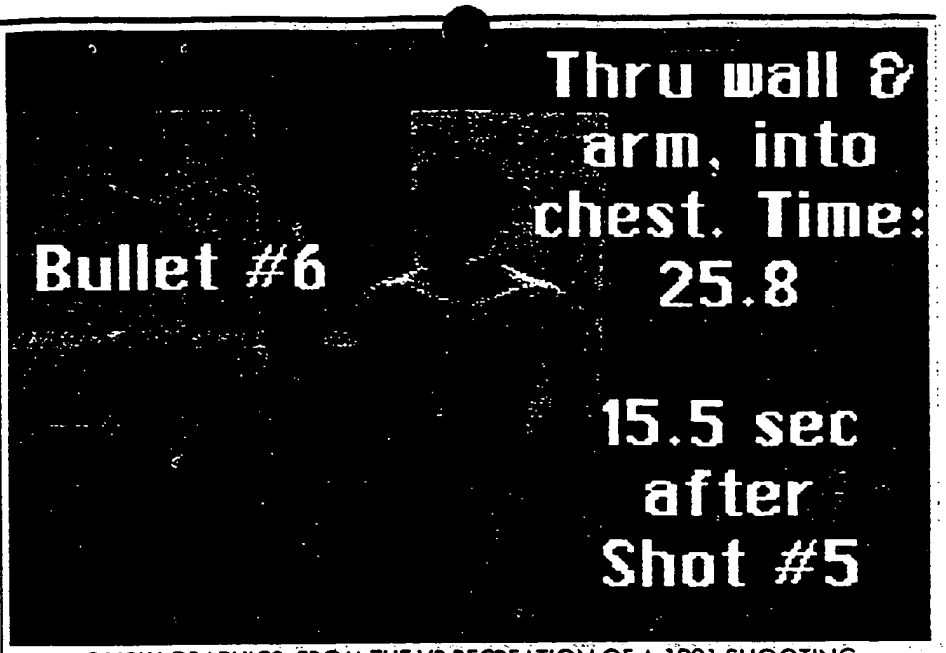
FLYING MICE. Such a system falls short for VR purists, who argue that only an immersive experience with a helmet holding two stereoscopic screens and headphones will do. That way, you see and hear only what the computer generates, interacting with the environment as in the real world. At NASA Ames Research Center in Mountain View, Calif., this approach lets you look around the surface of Mars, which has been recreated from satellite data. A motion sensor in the helmet lets you look in any direction, and the computer rerenders the scene to reflect your new perspective on the Martian landscape.

Still, theater-style simulations and two-dimensional computer displays can be just as powerful. Using a Silicon Graphics Inc. system, urban planners in Los Angeles are building an 80-block-by-80-block virtual model of renovation plans for riot-damaged areas. The value: It's hard for untrained people to read blueprints, and models are expensive. Yet, community involvement is essential. This way, residents can use a mouse to "fly" through the streets as if they were in a helicopter. And designers can pop in a park bench or delete a 7-Eleven, testing suggestions from those who live in the real Los Angeles.

The idea of using computers to render useful environments dates back to the 1960s. Back then, however, the computing power needed to generate even crude 3-D graphics was so expensive that only government agencies such as Defense or NASA, plus a few university labs, could afford it. Even today, special helmets used for military flight simulators can cost $1 million.

The field began to attract attention when onetime computer hacker Jaron Lanier coined the term virtual reality in the mid-1980s. In 1984, he founded VPL Research Inc. in Foster City, Calif.—the first company dedicated to VR worlds (page 104). VPL has developed key VR aids—head-mounted stereo screen displays, or "eyephones," plus the "dataglove" and the "datasuit," which let VR viewers convey information to computers with hand signals. Don a Dataglove, and an image of a hand appears in the virtual world, so you can point to objects, pick them up, or command the computer.

More than anything else, though, the relentless increase in performance—and decrease in price—of semiconductor chips is driving VR by allowing computer



GRISLY GRAPHICS: FROM THE VR RECREATION OF A 1991 SHOOTING

IS VR REAL ENOUGH FOR THE COURTROOM?

On the night of Feb. 27, 1991, San Francisco porn-movie king Jim Mitchell drove to the home of his younger brother and business partner, Artie, in Corte Madera, Calif. Minutes later, Artie was dead, and a dazed Jim was arrested walking away from the scene.

The district attorney didn't buy Jim's story that he shot eight times in self-defense, frightened by a beer bottle an intoxicated Artie wielded in a dim hallway. But there were no eyewitnesses. So, the prosecution persuaded the judge to let the jury watch a video of Artie's death.

This was no candid videotape, however. In the first-ever use of VR in a criminal trial, a ballistics expert recreated the event, complete with bullet trajectories, on a personal computer using computer-aided design software from Autodesk Inc. In the animation, a ghostly figure peeks from behind a door. The figure emerges and walks stiffly down a hallway. A red tube pierces, then exits, the body. The figure continues to walk until another red tube strikes its forehead.

The video, which was created after analyzing evidence found at the scene, had the desired effect. Last Feb. 19, the jury convicted Jim Mitchell of manslaughter and sentenced him to six years in prison. He's appealing, in part because of the videotape, which his attorney, Nanci Clarence, calls "wizardry that has no place in a court of law."

The Mitchell case highlights the ethical dilemmas inherent in VR. Reality is, after all, more than sophisticated software. To the defense's chagrin, for instance, the figure in the tape doesn't wield his beer bottle in a remotely threatening way. In short, VR may raise a thorny question for judges: Even in the best of simulations, can reality be manipulated unfairly?

makers to build more sophisticated graphics systems. At the high end, Silicon Graphics' new $100,000 "Reality Engine" has a computing speed 1,000 times as fast as most PCs, allowing it to provide quick rendering and real-time motion in VR worlds. On the low end, desktop VR systems based on Intel Corp.'s 486 chip cost as little as $20,000. Richard H. Dym, general manager for multimedia at Autodesk Inc., calls new programming tools and applications for these systems the leading edge of software development.

Entertainment is one of the first beneficiaries. Nintendo Co.'s $99 Powerglove, a simpler version of VPL's $8,800 Dataglove, lets video-game wizards play with hand gestures and has already helped spawn a host of VR-like video games. Virtual World Entertainment LP's VR game site in Chicago, the "Battletech Center," has sold some 300,000 tickets at $7 each since it opened in July to players who sit in an enclosed cockpit to engage in *Star Wars*-like battles. The company has two sites in Japan and plans to open 17 more over the next three years.

'TELEPRESENCE.' In business, much VR technology will evolve out of current computer systems. Computer-aided design, or CAD, systems have been around for years. Adding VR's greater resolution and interactivity can enhance their utility, as Chrysler, among others, is discovering.

"Telepresence," a VR tool that refers to the remote manipulation of equipment, shows similar potential. The Japanese construction company Fujita Corp. has hired VPL to help it build a system that lets an operator in Tokyo direct a spray-painting robot anywhere in the world. The operator views the building to be painted on a computer, then works controls that signal the robot to spray. With VR, the image is so painstakingly exact that the human operator makes no mistakes in directing the operation.

In business education and job training, VR's chief benefit would be lower costs. The Electric Power Research Institute has teamed up with MITRE Corp. to determine if an electronic mock-up of a power-plant control room using stereo projection displays can be effective in training plant operators. Today's training rooms for fossil-fuel plants cost up to $1 million. Using VR, the cost might dip under $100,000. And eventually, says Hugh W. Ryan, director of new-age systems for Arthur Andersen Consulting, VR worlds will be used to simulate business interactions—from sales negotiations to general management problems—and will replace some of today's expensive seminars and classes.

VR may also help train workers for flexible manufacturing. Boeing Co.'s project manager for human-computer interactions, Keith Butler, is developing

VIRTUAL MODELS: Northrop Corp. engineer Robert Joy uses a VR system to design parts for the Air Force's F-18 fighter jet in virtual space, lessening the need for expensive, time-consuming physical mock-ups

techniques to project job instructions onto see-through goggles worn by assembly workers or onto the work space in front of them. In theory, instructions presented this way could replace hours of training in which workers learn jobs, then must be trained again when the task changes. With such displays, a worker might assemble wing flaps, then switch to nose cones on the same day with little loss of productivity.

In perfecting such systems, developers must solve some novel problems. Why do some people become nauseated when navigating in cyberspace? And if you have to make a trade-off between complex, realistic graphics or live-action motion, which is more important for maintaining the illusion of reality?

The answers to such questions lie in the cognitive and behavioral sciences. Greater knowledge of the structure of the brain, how it processes information, and how people think and perceive is the key. Such research already indicates why VR worlds are so effective in training, says Roger Shank, director of the Institute for the Learning Sciences at Northwestern University. Studies show that in general, people reason or solve problems based on cases, examples, and experience, not by learning rules. "That's why the flight simulator is the best piece of educational software ever made," says Shank.

GENETIC CUES. One of the key assumptions of VR work is that the brain can process information better when it is presented through sight, sound, and touch instead of just text or numbers. Scientists also are finding that the responses to certain visual cues—including hand-eye coordination and the ability to detect the edges of objects and to recognize movement across a meadow of grass—are encoded in genes. Our cave-dwelling forebears originally developed these responses in reaction to the world around them, says Ronald M. Pickett, professor of psychology at the University of Massachusetts at Lowell.

Pickett and others are designing software icons that mimic those cues. "We want to trick the visual system to evoke quick, natural perceptual processes in the service of analyzing data," he says. To do that, he has created an icon that looks like grass. It changes length, curve, and arc to represent numeric data such as income level, age, and sex. Each icon can convey multiple characteristics that can be comprehended at a glance.

Whether people experience virtual worlds as "real" doesn't depend entirely on real-time motion, graphics, or visual cues, however. One of the most difficult challenges is to imbue computer characters with humanlike qualities. As part of that effort, Joseph Bates, a computer scientist at Carnegie Mellon University in Pittsburgh, is trying to create VR drama—interactive programs in which com-

WAR GAMES: The Pentagon is sharpening soldiers' skills with computer-generated battlefield exercises that unfold on huge screens

puter characters and people collaborate to create stories or situations. At first, it's hard to understand how an animated landscape with four bouncing blobs could be relevant. The blobs' only activity is jumping up and down, and they are supposed to take turns "leading." But when one ball starts to dominate the activity, the others react. They change color, or slow down. One even turns from red to blue, retreating to a corner, its sides heaving, to . . . well, sulk.

The balls appear to be exhibiting emotion and acting independently because Bates and his colleagues have programmed them based on theories of behavior. These hold that emotion—and the behavior that results from it—arise from goals that are being met, opposed, or otherwise affected. When programmed this way, the blobs begin to act as if they have "personalities," and people can identify with them.

'BARFOGENIC ZONE.' Building on such work, researchers one day hope to populate virtual worlds with creatures—human-looking or not—that people interact with as they would another person. These characters might analyze a problem, monitor an experiment, or play the role of someone in a business simulation—a hot sales prospect, say. They would probably react to voice commands but would also need to convey and understand more subtle human communication such as body language. Sound fantastic? Not to Fujitsu Ltd., which has invested $250,000 in Bates's work. His work reinforces Fujitsu's research in "artificial life," computer algorithms that behave like biological entities and could become the basis of computer-generated characters in VR worlds.

Fine-tuning the sensory and psychological factors that make a VR world "real" is a further technical challenge. Experience shows that VR viewers adjust to low-resolution monitors. The brain also accepts slow, jerky frame speed and much faster live action—30 frames per second. But in between lies what Thomas P. Piantanida, principal scientist of SRI International's Virtual Perception Program, calls the "barfogenic zone"—from 4 to 12 frames per second. At that speed, the confusion between what the brain expects and what it sees can make viewers sick. Until computers can create complex worlds with live motion, Piantanida's work suggests that it's better to run crude displays faster than to run detailed displays in the barfogenic zone.

Putting sound to virtual worlds is one more key to improving people's ability to absorb information. "Our ears point our eyes," says NASA Research Psychologist Elizabeth M. Wenzel, an expert in adding 3-D sound to virtual environments. A military pilot, for instance, often monitors as many as eight conversations from air and ground sources through the same earpiece. Wenzel says that making the sound appear to come from different directions helps pilots key in on high-priority information. A new circuit board developed by NASA and Crystal River Engineering Inc. that produces 3-D sound will make it easier to put sound in virtual worlds. The chips mimic the shape of sound waves as they hit the human ear from different directions, creating the illusion of distance as sounds grow louder and softer.

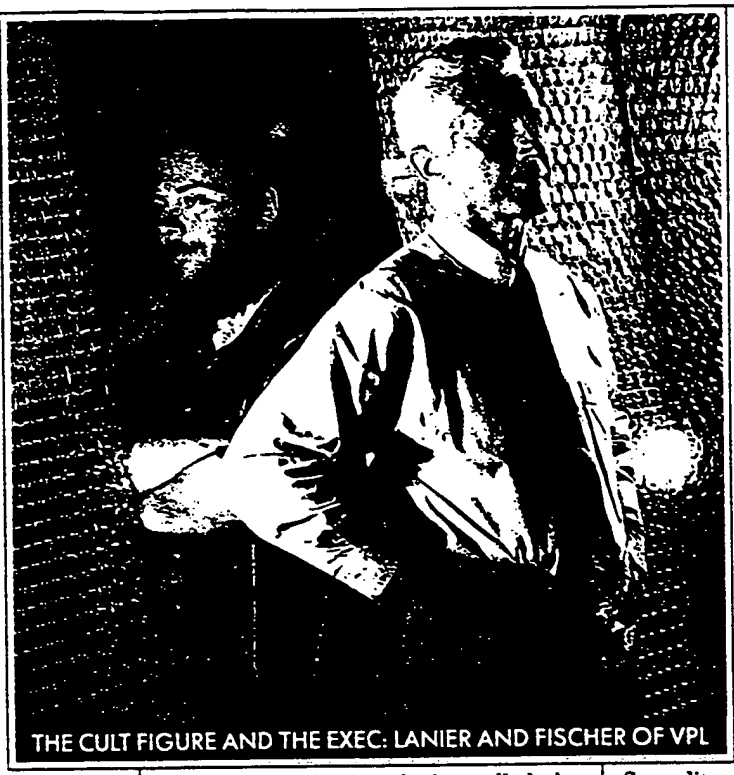
VR researchers are opening another portal to the brain through so-called force feedback. The idea is to build weight, resistance, or attraction into joysticks, so that VR voyagers can "feel" simulated objects. Researchers at Digital Equipment Corp. are working with outside chemists to simulate the forces of molecular attraction and repulsion. Their goal is to develop a system within two years that will help chemists feel these forces as they experiment with 3-D images of molecules to develop drugs and other chemicals. That's important because molecules that appear to be compatible often are not. Knowing this in advance could help scientists avoid blind alleys.

THE BLOBS: Carnegie Mellon University's Joseph Bates has created animated characters that exhibit emotions based on theories of human behavior. The next step: Virtual worlds filled with creatures that can interact with humans

The more sophisticated VR worlds become, the more controversy they may generate. Some psychologists want to use VR in psychotherapy to alter the perspective of patients, or to recreate environments that cause stress or other problems as a way to help treat phobias, depressions, and schizophrenia. British psychologist Peter Ward, who plans to use VR to

GOING WHERE NO MINDS HAVE GONE BEFORE

To get a feel for what is different about virtual reality, meet Jaron Lanier, chairman of VPL Research Inc. Dreadlocks crown his ample frame. His Sausalito (Calif.) studio—he's an accomplished musician—is filled with exotic instruments. On the door hangs his image emblazoned on a psychedelic poster. The poster is hot in Europe, where VR is *très trendy* and Lanier is a cult figure, reflecting VPL's preeminent role among the startups that are pushing the technology's frontiers.



THE CULT FIGURE AND THE EXEC: LANIER AND FISCHER OF VPL

Lanier, 33, started VPL in his garage eight years ago with money he made from programming an Atari Corp. video game called Moondust. Fiddling with icons and graphics he hoped would make math easier led him to a more sweeping vision. Today, VPL sells hardware devices such as the Dataglove and Datasuit for navigating in virtual space, helmets that surround you with computer-generated worlds, and programming software that even children have used to create virtual environments—kids, and a few other customers, such as Boeing, SRI International, Matsushita, and MCA.

THE 'BOOM.' VR's big winners eventually should be heavyweights such as Intel, IBM, Apple, and Silicon Graphics—the makers of graphics chips and computers. Alan Meckler, publisher of the newsletter *The Virtual Reality Report*, sees liftoff toward the end of this decade. But whoever cashes in will owe a debt to VPL and many other innovators. Crystal River Engineering in Groveland, Calif., is selling acoustical circuit boards that let programmers put 3-D sound—say, the sound of a door opening and closing—in a virtual space. Fake Space Labs has invented a stereoscopic viewing device called the "boom"—as in boom microphone—that lets a person move around a virtual space by looking through a viewfinder.

Lanier thinks medicine will be VR's "monster market," partly because of the need for better visualization of diagnostic scans. At a recent San Diego conference, surgeon-inventors mingled with science fiction writers, while Sony Corp. marketers pitched high-definition-television screens. The other products discussed ranged from systems for doing remote surgery to 3-D data bases for analyzing casualty data in a war.

The core of such markets will be software, says Robert Jacobson, founder of WorlDesign in Seattle. StereoCad in Sunnyvale, Calif., and Virtus in Cary, N. C., specialize in architectural and engineering design programs. BioCad in Mountain View, Calif., sells "virtual chemistry" software that lets scientists create 3-D, interactive models of molecules and other chemical structures. Engineering Animation Inc. in Ames, Iowa, makes 3-D graphics and animation programs that recreate accident scenes for use in court. Both SenseS and VPL sell "tool-kit" programs for VR software programmers. But they may not rule the market for long. Autodesk Inc. in Sausalito, which has 700,000 customers for its computer-aided-design software, could have an edge when it comes out soon with its own tool-kit program.

BETTER ENTREE. Such competition has begun to alarm Lanier, a major VPL shareholder. In May, he named a new chief executive: ex-Hewlett-Packard Co. executive Walt Fischer. As white collar as Lanier is not, Fischer may have better entrée to corporate customers. This could be crucial for VPL's plan to become a systems integrator, selling packaged solutions—not just components. "We've sold millions of dollars' worth of hobby stuff," says Lanier. "The transition now is into a real company."

Whether VPL and the other VR upstarts will prosper is impossible to predict. But even if they do not, pioneers such as Lanier are trailblazing a technology that is likely to benefit every industry that relies on computing.

By Joan O'C. Hamilton in Sausalito, Calif.

PIONEERS IN VIRTUAL REALITY

THESE VR LEADERS ARE ALL PRIVATE COMPANIES

Company	Location	Employees	Founded
VPL RESEARCH	FOSTER CITY, CALIF.	25	1984
Makes hardware and software, including DataGlove and EyePhones			
SENSE8	SAUSALITO, CALIF.	8	1990
Creates programming packages for virtual worlds			
FAKE SPACE LABS	MENLO PARK, CALIF.	7	1989
Makes stereoscopic viewing device			
SIMGRAPHICS	SOUTH PASADENA, CALIF.	15	1985
Develops engineering visualization programs			
GREENLEAF MEDICAL SYSTEMS	PALO ALTO, CALIF.	12	1988
Adapting the DataGlove for use in medicine			
EXOS	WOBURN, MASS.	25	1988
Sells a device that signals computers through gestures			

treat spider phobia, thinks some patients may feel more comfortable with a machine than with a human therapist.

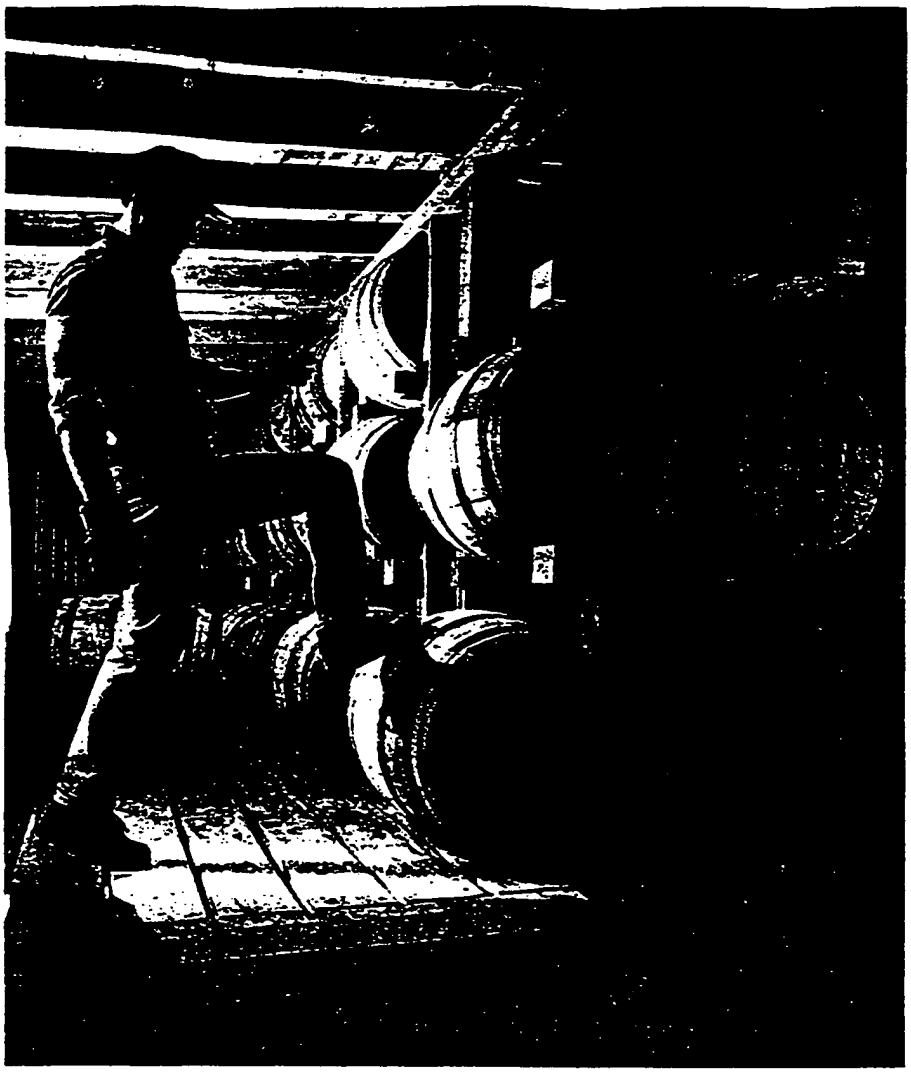
Still, simulations with the power to make soldiers sweat might wreak havoc on fragile psyches. Indeed, widespread use of VR, some worry, could influence people in harmful ways. Could immersion in VR worlds incite violence, become addictive for some people, or lead to computer-generated manipulation of others? It will be years before anyone knows for sure. But, muses Bob Jacobs of Illusion Engineering, which develops military simulations: "We may eventually need a code of ethics for cyberspace."

In fact, a down-to-earth dilemma arose this year when a VR program helped convict a man of manslaughter in California (page 99). And some critics believe that VR training exercises could alter the view of what constitutes valuable work experience. Take two candidates for the job of nuclear-plant manager. Who should get the nod—a veteran plant worker with a decade of no mistakes, or a less experienced candidate who scores higher in simulations of disaster? "This scares the hell out of some hierarchical types," says Michael W. McGreevy, principal engineer at NASA's Aerospace Human Factors Research Div.

BLURRY VISION. Formidable hurdles remain before VR systems can reach their full potential. "We need a whole bunch of technologies that are still in their infancy," says VR pioneer Henry Fuchs, professor of computer science at the University of North Carolina. Researchers are only making slow headway toward improving today's often blurry head displays. And a camera that digitizes the image of a room and turns it into a VR environment remains elusive: So far, computers can't distinguish between edges, lines, and shadows sufficiently to translate a video image into 3-D. It's no easy task to get so many disciplines—programming, behavioral science, and hardware design—to work together to produce those advances.

The task is so arduous that some VR advocates worry about being engulfed by the cycle of hype, then hopelessness, that befell artificial intelligence. Still, VR represents a potent direction in technology. Inevitably, as computers gain more power, more work will focus on making the interactions between humans and machines more efficient. Watch a roomful of charged-up players in Chicago's Battletech Center go at it—oblivous to the real world—and you can't help thinking that you're seeing the makings of the ultimate tool for the mind.

By Joan O'C. Hamilton in San Francisco, with Emily T. Smith in New York, Gary McWilliams in Boston, Evan I. Schwartz in New York, John Carey in Washington, and bureau reports



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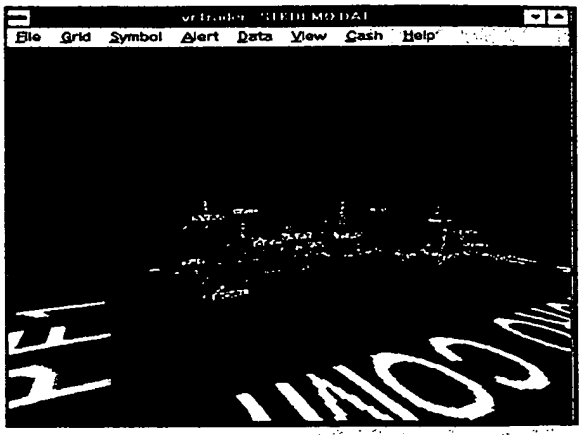

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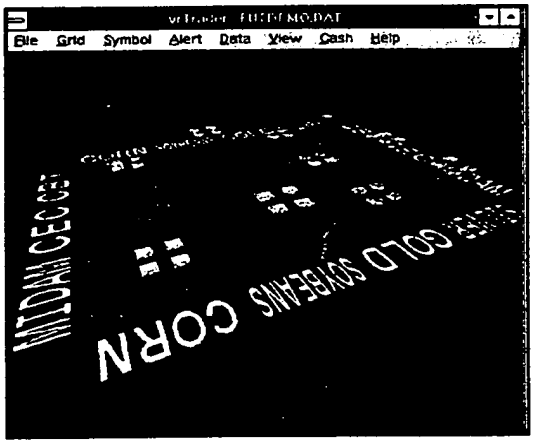

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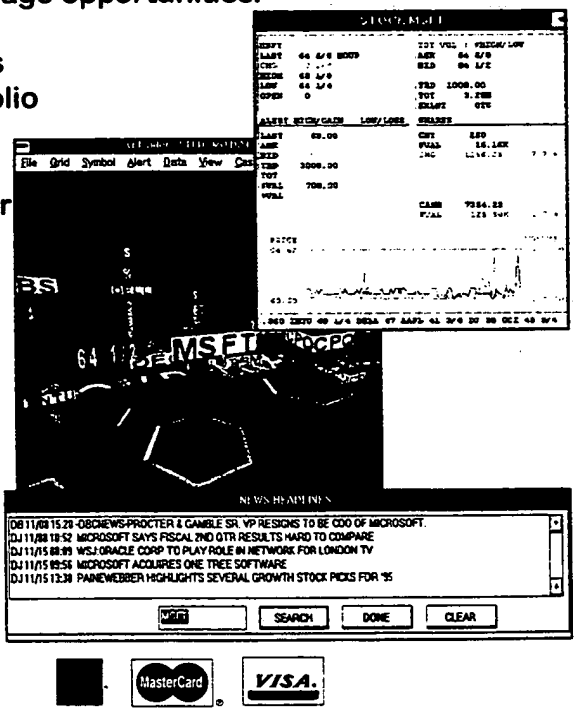

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